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AN ANALYSIS OF THE EXTENT TO WHICH AN
ENGINEER IDENTIFIES HIMSELF WITH MANAGEMENT
AT VARIOUS STAGES OF EXPERIENCE

A Thesis

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Henry E. Godke, Jr.
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ABSTRACT

SODKE, Henry E., Jr., M.S., Purdue University, June 1955.

AN ANALYSIS OF THE EXTENT TO WHICH AN ENGINEER IDENTIFIES HIMSELF WITH MANAGEMENT AT VARIOUS STAGES OF EXPERIENCE.

Major Professor: Ralph E. Balyeat; 140 pages, 8 tables, 4 figures, 16 titles in the bibliography, 8 appendices.

This study investigated the variability in certain attitudes expressed by non-supervisory engineers and students in engineering. The study is designed to determine just how an engineer and a student engineer identify themselves with management. How much is the student engineer management orientated in the universities throughout the United States?

As a basis for comparison four stages were chosen to discover whether there might be any significant differences in opinions of groups at various stages of maturity concerning self-identification with management. The stages are: (1) sophomore student engineer, (2) senior student engineer, (3) non-supervisory engineer with less than five years service, and (4) non-supervisory engineer with more than five years service.

A nation-wide survey was selected to provide a more representative sample of all the non-supervisory engineers and engineering students. Thirty companies and universities, whose names are presented in Appendices E and F, pages 102 and 104, agreed to cooperate with Purdue University on this project in response to letters of invitation. One thousand survey forms were sent to the universities, and 55.9 per cent were

returned. The number of survey forms sent to the companies totaled four hundred and sixty-seven, and 25.1 per cent were returned.

An opinion survey and an independent management identification scale were developed to measure a person's self-identification with management.

The following findings are submitted:

1. Sophomore students are found to have less identification with management than seniors; and non-supervisory engineers with five or more years of experience are found to have less identification with management than those with less than five years experience.
2. There was a decrease in identification for the non-supervisory engineers as compared with students which is significant at the five per cent level of confidence.
3. It was found that in our universities there was considerable variability in the student's self-identification with management.
4. Considerable variability in self-identification with management for the non-supervisory engineers existed within various companies.
5. That the more authority and contact with industrial workers the branch of engineering has, the greater the degree of self-identification with management for the engineer within that branch.

Chapter I

INTRODUCTION AND STATEMENT OF PROBLEM

I. Background

The graduate engineer of today steps into a strange organization at a relatively high level. He has had no opportunity to understand, through long association, the methods and operations of the concern. Many of our graduate engineers have grown to be the key men in industry. Their influence predominates in almost all functions of a modern industrial organization. Their technological understanding applies to the productive organization and to all levels of management, as well as to the directly technical pursuits in the department of engineering.

It is vitally necessary that the engineer should consider his position in management. In many of our present corporations we find a situation in which the owners do not manage and the managers do not own. The engineer must compete for the right to be in management. In order to do so, he must improve his shortcomings. Normally the engineer has considerable interest in technical perfection and the business man has a healthy appetite for profit. Both perform an important function, serving the people and keeping the technical perfection under economical control. With the industry of today getting more and more technical in nature, it is obvious that an engineering background, although not a requisite for a top-management man, is an extremely valuable quality.

The engineer, whether he wants to or not, finds himself involved in assuming an executive role in many industrial organizations. This may not be apparent to the young engineer, but one out of every three (1) engineers becomes a manager or an executive. Advancing to the fields of management, the attitudes that the engineer brings with him will determine the policies to be followed by our industrial workers. If our source of competent managers with technical understanding and techniques of manufacturing are drawn so heavily from our engineers, why not indoctrinate and equip them in our universities and companies with the tools and attitudes of management?

The non-supervisory engineer represents one of the most important groups in our industrial system. Psychologically, economically, and socially, their attitudes are important because they include the cornerstone of progress in the present-day world. The attitudes which will be retained by these non-supervisory engineers when they become executives or managers should be of great interest to their employers. If these attitudes are not cultivated by our universities and companies in a correct and direct manner, we may all face the impact of a radical and deliberate change from a system of free enterprise to that of a recognized form of unionism.

For the past twenty years we have seen a steadily increasing number of our engineers seeking the advantages

of our unions. Why should they turn to unions? Is it because our universities and companies have neglected them?

In the past forty or fifty years we have seen a change in the status of the professional engineer from an independent consultant to a salaried person. Many of the engineers work as a member of a team in which there is individual application of engineering and scientific skills applied to a specific project. The result is to blur the lines of distinction between the engineer and the technician. This in turn reflects a conviction that the engineer's status in industry relative to other groups has declined. Thus the engineer has somewhat reluctantly turned to unionization. Just what will be the effect in twenty years from now when these same engineers who have turned to unions will be managers in our industrial organizations? Many other questions may be asked relative to the present situation. All of this discussion gives a background from which this project stems.

II. The Problem

This study will investigate the variability in certain attitudes expressed by non-supervisory engineers and students in engineering. The study is designed to determine just how an engineer and a student engineer identify themselves with management. How much is the student engineer management orientated in the universities throughout the United States? Is this management orientation changed among the groups at

various stages?

No one has experimentally questioned the desirability of trying to make non-supervisory engineers feel a part of management. But what are the consequence of the identification of non-supervisory engineers with management? How does management identification affect the non-supervisory engineer's effectiveness as a work group staff member?

The training received in the various engineering curricula in any college may differ more than that received in the same curricula in other colleges. But does the atmosphere of a given type of college affect opinions sufficiently to cause a difference? What factors of background and experience do college engineering students associate with favorable attitudes toward self-identification with management? Thus the study of sophomore and senior students in our engineering colleges is included in an attempt to prove or disprove the opinion that attitudes of university students toward the philosophy of industrial management vary extremely from university to university.

As a basis for comparison four stages were chosen to discover whether there might be any significant differences in opinions of the groups at various stages of maturity concerning self-identification with management. The stages are:

1. sophomore student engineer
2. senior student engineer



3. less than five years engineering experience
4. more than five years engineering experience

In order to discover whether there might be any significant differences in opinions on self-identification with management between students of different types of colleges and universities, a comparison was made between them. A similar comparison of companies stratified to size was also made. The technique employed was an analysis of the mean of each group in testing null hypotheses.

III. Attitude Defined

The present definitions of attitudes are not all in agreement. Probably the most widely used and generally accepted definition of attitude is that proposed by Thurstone and Chave (2):

The sum total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specific topic.

Kantor (3) defines attitude as:

An intellectual position taken with respect to things, persons, and conditions -- in more positive form one's attitudes constitute opinions and beliefs.

Allport (4) defines attitude as:

An attitude is a mental and neural state of readiness, organized through experience, exerting a directive influence upon the individual's response to all objects and situations with which it is related.

In the present study the matter of definition of attitude is not considered to be of great importance. The definitions

quoted are in general satisfactory. For summarized form we might think of an attitude as the emotional acceptance (or rejection) of a situation.

Chapter II

DESCRIPTION OF THE GROUP AND SAMPLING

I. Source of Subjects

The nation-wide survey was selected to provide a more representative sample of all the non-supervisory engineers and engineering students. The elementary units are the non-supervisory engineers and engineering students. The entire group whose characteristics are to be estimated is the population. Thus the population consists of two different groups -- students of universities professing the desire to enter the fields of engineering, and non-supervisory engineers that are in the field.

The students were limited to sophomores and seniors from colleges and universities that have curricula for engineering education. The non-supervisory engineers in the field were limited to companies that had over one thousand personnel in their employ.

II. Method of Sampling

In an effort to control sampling error the use of available resources was considered of primary importance. The sampling error is, of course, dependent upon the population variance and to a limited extent upon the size of the population, but these factors are not controllable by the investigator if simple random sampling of elementary

units is used. An investigator is often able to effect increases in efficiency in sample design by utilizing available resources in the form of maps, lists, census information, and other information. One way of making effective use of available information is by stratification. There are a number of methods by which to obtain a stratified sample.

Stratification is used in the selection of colleges and universities. These colleges and universities are conveniently listed in the "The Journal of Engineering Education," vol. 44, No. 6, February, 1954. The United States is divided into fifteen sections, and the number of engineering educational institutes are listed in each section. To make use of this available information a stratified sample was selected. The method of selection was to have a total of twenty-five representative engineering institutes picked randomly in the United States.

This stratification was accomplished by using proportions of the sections of the available institutes. Once the number in a section was determined, a random sample was obtained from engineering professors within these colleges. By insuring the desired representation of the major universities and colleges, it is felt that greater precision can be accomplished in the sample estimates.

The proportionate stratified sampling has still left the student engineer a chance to be included in the sample and the sample estimated is considered unbiased.

The selection of the non-supervisory engineers in the field is considerably more difficult. A research in the literature of the designs, and results of some actual sample surveys conducted, revealed that one of the better techniques of sample surveying is being employed by the Bureau of the Census in its annual survey of manufacturers. Because of the inability to provide the necessary funds to obtain such a representative sample, a simple random sample technique was used before cluster and systematic sampling. Perhaps this technique can be justified when we consider the uncontrollable factors that make up the population of non-supervisory engineers. The graduated student will normally choose a job that will carry him to any of the sections that we have stratified.

The difference in policies of individual companies throughout the United States would offer no advantages to this study of sectionizing by areas and making an analysis of comparable sections. Thus it was felt that a simple random sample of companies and corporations employing engineers should be obtained. The technique used was to enter Pool's directory (5) and randomly select fifty companies with the following criterion: the size of the company selected must be one thousand employees or more. It is felt that the cost would be too excessive to include companies of smaller size. Also, it was found that the smaller companies did not employ enough engineers to

warrant participation. It is realized that some amount of sampling bias enters in at this stage, because not every engineer will have the opportunity to be represented. The amount of sampling bias cannot readily be calculated, and all the results involving the engineer in the field will carry this bias, which may be either negligible or considerable. The economic use of funds has made it necessary to employ this criterion and limit the number of companies to fifty.

From this simple random sampling of fifty companies a proportionate stratified sampling was used to give each unit in this population an equal chance of being included. The estimates from this proportionate stratified sampling, if the sampling is properly constructed, will be consistent and carry no biases. The companies were stratified by the number of employees employed within the company and by questionnaires sent to the companies for distribution, as in Table 1, page 11.

It was predicted that 1,000 forms would be enough to print for this group because not all would participate in the questionnaire administration. It should be noted that cluster sampling was employed in this table. Cluster sampling normally carries with it a little larger sampling error than simple random sampling (6).

TABLE 1
BASIC SAMPLING FRACTIONS BY ESTABLISHMENT SIZE

Employment in 1954	Number of Companies	Number of surveys to send	Total number required
1,000 -- 5,000	12	10	120
5,001 -- 10,000	14	20	240
10,001 -- 25,000	14	40	560
25,001 or more	10	50	500
Total. . . .			1,420

III. Cooperation of Universities and Companies

Since the results of this survey can be used by the industrial managers and universities it is felt that they are solely responsible for its application and solution to industrial relation problems. My first task was to involve top management of fifty randomly selected companies. In addition an attempt was made to involve twenty-five universities and colleges that teach engineering. It was felt that to make this project a success, I would have to make some one in management feel personally responsible for the success of the undertaking.

In order to secure their cooperation, a personal letter was sent to each of the selected companies and universities explaining the project, requesting their participation, and assuring them that they will receive a copy of the results. A sample of the personal letter is included in the Appendix A, page 90, along with a sample of the returned postcard. This assisted in the reduction of the cost for the project as well as reducing the number of non-returns. This indication of participation helps produce the involvement so necessary to the success of this survey.

IV. Administering the Questionnaire

The administration of the survey was accomplished with the following criteria. First it is essential that

the non-supervisory engineer be chosen in some random fashion. Due to the various conditions existing at the different companies and universities, a set of instructions were prepared and mailed with the questionnaire for the administrator to follow. The different ways to administer the survey were listed in descending order of best way to distribute the questionnaires. This set of instructions and letter of transmittal are included in Appendix B, page 93.

Second, the non-supervisory engineer and students were given necessary instructions on the front page of the questionnaire itself. These instructions assured them that the results will not become a "club" which can be held over their heads. They were asked not to sign their name and the questionnaire remained anonymous.

Chapter III

DEVELOPMENT OF THE QUESTIONNAIRE AND WORKABLE SCALE

I. General

The use of scientific attitude measurement in the industrial field has increased sharply in the past few years. The tremendous increase in the number of engineers being utilized in a modern industrial plant makes it impossible for top management to have personal contact with all of its engineer employees. Along with this is the growing consciousness of social responsibility in industry. As a result of all these changes, management has been forced to seek out or invent new methods of discovering the attitudes of the engineers.

The field of attitude measurement has become a major area of research in the past generation. The industrial relations personnel, psychologists, economists, sociologists, and statisticians have all contributed techniques of great value. It is apparent that industry must know the attitudes of its engineers and employees if it is to have a harmonious labor relation. The present trend of increasing engineer unions motivates our thoughts on just how this will affect our labor relations with them.

New measuring devices and statistical procedures are being developed for attitude measurement. These new devices and procedures are designed for emphasis on a

scientific evaluation of attitudes. Considerable research has been done by McNemar, Thurstone, and Chave, Lawshe, Guttman, Harris, Likert, and others (7,8,9,10,11), on the problems of reliability, validity, scaling techniques, and statistical analysis. This survey which is employed to fulfill a purpose may not meet all the statistical criterias of excellence, but the author has strived to use the tools of statistics to accept or reject the hypotheses made.

II. Design and Development of the Questionnaire

The problem of designing and developing a questionnaire is quite obviously basic to the whole project. Any results made from the survey will be dependent upon the decisions made at this stage. Considerable time was devoted in research for suitable questions to be included in the survey. Other surveys such as morale surveys were consulted. It was realized that previous questions that were good, or had been tested previously, and retained through a scaling technique would help tremendously in this questionnaire. Unfortunately none of the questions in the morale questionnaires consulted seemed to be applicable or provide enough specific coverage for this project's intended purpose.

Another problem encountered when developing this questionnaire, which is to serve both universities and companies, is that of getting items which are equally applicable to students as well as engineers in the field. At the same time the items should be specific enough to be answered

by both students and engineers. In general, the subject areas chosen were based upon specific issues that would show a disagreement between management and non-management identified persons.

In order that the questionnaire construction might be in keeping with accepted statistical procedures, the following criteria were set up as a guide.

Survey Criteria:

1. The survey should be valid. A survey is valid if it measures what it purports to measure.
2. The survey should be reliable. A survey is reliable if it gives consistent results.
3. The survey should be within the comprehension of the participants; vocabulary should be simple and phraseology clear. Ambiguity should be avoided.
4. The survey should be as brief as possible; yet it should contain enough items to secure a fair sampling of each individual's opinion.
5. The survey should contain degrees of items which normally are answered in the different degrees by all, or nearly all subjects.
6. The item content should not be duplicated.
7. The method of responding should be easy, and it should conform with practices understood by the subjects.
8. The survey should be easy to administer.
9. The items should test opinion only, not factual knowledge.
10. The survey should cover the following objectives:
 - a. determine engineers identification with management
 - b. determine engineers compatibility with management goals and objectives.

Approximately one hundred questions were designed in an effort to meet the above criteria. Four professors individually discarded the major portion of these questions. Out of the original one hundred questions thirty survived this initial screening. These thirty items are included in the questionnaire in the Appendix C, page 97.

III. Design of a Workable Scale for the Questionnaire

The early work of attitude scaling was done by Thurstone (2) who used the method of equal appearing intervals. Scale values are placed on a continuum by a number of judges. The disadvantage of this type lies in the use of questions that are adverse to the company and has been pointed out, that, why irritate the companies with adverse questions that will just as likely cause them to discard the entire set to the circular file.

Likert (11) varies from this method in that items are assigned predetermined weights ranging from 0 to 4, and the final scale selection is on a basis of internal consistency. The technique developed by Guttman (9) is used to investigate a set of items in order to ascertain whether or not the items are attributes of a universe of qualitative data. Edwards and Kirkpatrick (12) have contributed by combining the methods of Thurstone and Likert for a scale which is then in turn subject to analysis with the Guttman Cornell Technique. The development of the method of Reciprocal

Averages has been credited to Richardson (13). His scale values are obtained by determining mean total score values for respondents endorsing the items. Arbitrary weights are first assigned, the items scored, and new scale values determined. This process is continued until the necessary degree of refinement is attained.

The internal consistency of the items within a scale as determined in terms of discrimination or D-values is credited to Lawshe (8). Others have contributed to attitude scaling in attempts to find a workable scale to measure attitudes desired.

The method used in this analysis is a combination of some of the techniques used above. Because this study aimed to be quantitative, to find the extent to which an engineer identifies himself with management at various stages of experience, the development of a reliable instrument for measuring attitudes was fundamentally important. It is realized that in a good question the larger the significant difference of the pattern or response between the high and low morale groups, the better the question is. The same situation exists for an engineer's self identification with management. A good question would discriminate between those that do and those that don't affiliate themselves with management.

The type of items used in this questionnaire show degrees of response to each item. The degree response may

fall anywhere on the continuum of intended measurement. The weight from item to item may not be the same. This imposes many parameters to be handled. These parameters were considered in development of this scale.

Certain of these statements in the opinion survey had been framed with a view to incorporating them into attitude scale which would have greater reliability than any single item could possibly have. It should be emphasized that the scale measures only what their constituent items measure.

The method of constructing the attitude scale will perhaps be most clear if the completed scale, containing the items selected, are presented first, followed on how they were selected. The scale is included in Table 2, page 20. The remaining attitude items dealing with industrial practices and policies will be handled individually.

In order to obtain this scale which will provide a person an insight regarding the non-supervisory engineer's identification with management, judges were used similar to the technique of Thurstone. The judges were asked to select the items that in their opinion showed some degree of measurement of an engineer's self identification with management. These same judges were asked to screen the item response and indicate by code rating the location within five equal segments from no identification to complete identification. In other words certain statements seemed by the judges to be related to identification with management.

TABLE 2

THE MANAGEMENT IDENTIFICATION INDEX

- (1.01) 6. What is your concept on how management views the relationship of the non-supervisory engineer to management?
3.86 a. part of the management team
2.82 b. a professional employee with authority and responsibility
1.41 c. an employee with delegated responsibility
0.32 d. an employee with technical duties
- (1.04) 7. To what extent does the average non-supervisory engineer feel a sense of importance in his company?
3.88 a. very high degree of importance
3.00 b. high degree of importance
1.88 c. medium degree of importance
0.76 d. little degree of importance
0.06 e. very little degree of importance
- (2.14) 12. To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?
0.00 a. very advantageous
0.05 b. some advantage
0.55 c. very little advantage
1.82 d. no advantage
2.77 e. some disadvantage
3.68 f. considerable disadvantage
- (0.82) 15. To what extent do companies have personnel policies differentiating between engineers and non-professional men?
0.11 a. no differentiation
0.94 b. slight differentiation
2.50 c. considerable differentiation
3.56 d. complete differentiation
- (1.77) 16. An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?
3.62 a. will considerably minimize his opportunity
2.10 b. will somewhat minimize his opportunity
0.67 c. will not effect his opportunity
0.19 d. will somewhat increase his opportunity
0.00 e. will considerably increase his opportunity

TABLE 2 CONTINUED

- (1.04) 17. The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.
3.06 a. agree 0.29 c. probably disagree
1.88 b. probably agree 0.06 d. disagree
- (0.85) 18. How often are most engineers informed on company matters of interest and importance to them?
0.00 a. never 2.61 d. usually
0.17 b. seldom 3.67 e. always
1.28 c. occasionally
- (1.26) 19. A company should distribute net profits
3.28 a. to investors of the concern
2.39 b. to investors and employees at the company's discretion
0.78 c. to investors and employees on a definite basis
- (10.13) 20. Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.
3.23 a. professional status and prestige would be damaged
2.77 b. a "typing" of engineering positions and a "leveling" of salaries would result
0.32 c. the principles and practices of democracy would be enhanced in the engineers group relations with management
2.68 d. the principles and practices of democracy would be endangered in the engineers group relations with management
0.23 e. employment security would be increased
2.91 f. individual initiative would be restricted
0.23 g. reduce undesirable discriminatory treatment
2.73 h. individuals would be regimented by the union organization
0.09 i. economic standing would be improved
- (1.57) 21. Most companies have gone beyond the optimum point providing fringe benefits to employees.
2.88 a. agree 0.47 c. probably disagree
1.76 b. probably agree 0.00 d. disagree
- (1.66) 22. Personnel practices of most companies tend to maximize the contribution of their engineer personnel.
2.94 a. agree 0.50 c. probably disagree
2.25 b. probably agree 0.31 d. disagree

TABLE 2 CONTINUED

- (1.23) 24. Companies should promote engineers solely on basis of merit.
3.82 a. agree 0.71 c. probably disagree
2.76 b. probably agree 0.06 d. disagree
- (1.32) 25. How often do you feel you will (or) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?
0.32 a. seldom 2.73 c. usually
1.32 b. occasionally 3.77 d. always
- (0.86) 27. To what extent do most industrial unions encroach upon areas that should be reserved for management?
3.57 a. in many areas of management responsibilities
2.05 b. in some areas of management responsibilities
0.00 c. in no areas of management responsibilities
- (1.44) 33. The effect of collective bargaining on advancement for those with a high degree of ability and initiative will
3.23 a. reduce his opportunities considerably
2.50 b. reduce his opportunities somewhat
0.91 c. no effect on his opportunities
0.14 d. improve his opportunities somewhat
0.00 e. improve his opportunities considerably
- (1.24) 34. If an engineer has a personal problem or grievance it should be discussed and settled
2.70 a. by his supervisor
2.00 b. by a management panel
0.10 c. by formal grievance procedures
- (0.77) 35. To what extent do you think the industrial policies within a company should be set by management or labor?
3.82 a. it is the management's right to set all policies
2.09 b. decisions made by management with representation of labor on policies affecting employees directly
0.05 c. it is the labor's right to have joint determination on all policies

Maximum possible score. 69.66
 Minimum possible score. 3.04
 Spread 66.62

Where this is true it is possible to combine the related items into the management identification attitude scale. The item analysis instructions are listed in Appendix D, page 99. A composite rating for a response is now determined by taking the mean for each of the item responses. All questions that did not show seventy-five per cent or more in agreement for measuring identification by the twenty professors and graduate students were discarded at this point.

As one indication of the degree of relationship, the criterion of internal consistency was applied. This method shows the degree of relationship between each item and the total of combined items. It shows whether a statement really does measure the same thing that the battery measures, or simply, whether it differentiates between those that do and those that do not identify themselves with management.

For a particular attitude in question, the reactions of the self identified management group which represents one extreme are compared with the reactions of the other group who do not identify themselves with management which constitutes the other extreme. From a random sample of 200 questionnaires, the twenty subjects scoring highest on the battery and the twenty scoring lowest were selected, in order to examine their responses to individual statements. This data is shown in Appendix G, page 106.

The sum of the scores for the high group and of the low group on each statement are calculated, and the differences are found.

It should be noted that all statements show a positive difference except question number thirteen. This indicates that the original numerical values were properly assigned by the judges. Question number thirteen involves rank in order which you feel will count most in your prospects for promotion, and only the first choice was used. In the scale development the other choices were omitted and it is believed that if they could have been handled with this additional parameter of ranking, the question would differentiate positively. If the judges had scored the identification to the item responses incorrectly, then the extreme high group would have scored low on that statement, and the extreme low group would have scored high. In comparing the differences it is noted that not all are of the same magnitude and, therefore, the statements vary in their differentiating power.

Then in the final scale the eight statements showing the smallest differences were discarded. With this scale a composite score can be determined for each person that completes the questionnaire. The possible scores on the scale measuring attitude toward a person's identification with management range from 3.04 (representing no identification with management) to 69.66 (representing complete identification with management).

The discriminating power is shown proceeding the statement in Table 2.

CHAPTER IV

TABULATION AND ANALYSIS OF THE DATA

I. General

The tabulation and analysis of the data is directed towards a report which can be given to the companies and universities. Thus the analysis only serves to provide facts for the report and gives justification for certain interpretations. One of the first steps in the analysis was to transfer the data to a suitable size card for easier handling and tabulation of responses. This allowed a tabulation of responses from any of the stratified groups that were identified with considerably more ease than handling the questionnaires directly.

II. Tabulation of Survey Returns

The number of questionnaires sent to universities and colleges totaled 1,000 of which 559 or 55.9 per cent were returned. The number of questionnaires sent to companies totaled 467 of which 186 or 25.1 per cent were returned. Table 3, page 27, shows the number of companies and universities or colleges contacted, the number and per cent showing indication to participate, the number of questionnaires sent to each, and the number and per cent of questionnaire returns. Six weeks were allowed for the return of the survey forms and analysis. There were 98 forms that came after this and were not included in the thesis.

TABLE 3
SURVEY RETURNS

Source	Contacted	Indicate will participate No.	%	Survey forms sent	Returns No.	%
Universities	25	20	80.0	1,000	559	55.9

Companies by number employed:						
1,000 -- 5,000	12	8	66.7	147	105	71.4
5,001 -- 10,000	14	5	35.7	150	37	24.7
10,001 -- 25,000	14	4	28.6	170	44	25.9
25,001 or more	10	0	0.0	0	0	0.0

Table 4, page 29, shows a stratified breakdown of the returns by non-supervisory engineers and students. The per cent indicates the portion of that strata to the total return.

III. Statistical Methods

The next step was to determine the applicability and adequacy of the statistic to be used. The statistics used are a comparison of numbers or percentages and the significance of difference between them. The per cent or number of one group giving a favorable response to a certain item was compared with the per cent or number of another group giving that same response, and the difference was checked for statistical significance.

For purposes of statistical significance or inference or reliability, a hypothesis may be defined as a tentative assumption, stated as a generalization, which is to be tested from a sample. If I state there is no difference in the mean identification score between engineering students and non-supervisory engineers this is known as a null hypothesis. The null hypothesis, then, becomes the statement of research issue which may be evaluated by an appropriate test of significance.

The hypothesis serves to direct the investigation in the collection of appropriate evidence. Without the

TABLE 4
RETURNS BY STUDENTS AND NON-SUPERVISORY ENGINEERS

Strata	Returns	Per cent
Sophomores	245	32.9
Seniors	314	42.2
Less than five years	86	11.6
More than five years	99	13.3
Total. . .	744	100.0

hypothesis, the evidence collected is likely to be incomplete or inappropriate and the study may be reduced to sheer activity. As two sample means increasingly differ, the probability of the null hypothesis being tenable becomes smaller and smaller. The probability required for rejecting the null hypothesis is highly arbitrary but common practice has been to use the five per cent or the one per cent level. The former level, usually referred to as a significant difference, implies that the sample mean difference is so great that it would occur in less than five per cent of the samples from the population by chance alone.

It bears repeating that a significant difference as used within this project should not be construed as an important difference. A difference may be significant without any known social consequence and yet the sample difference might be highly important to the universities and companies.

Thus the significant difference is left to the reader for interpretation of importance. The interpretation which may be made whenever the null hypothesis is rejected presents some difficulty in semantics. It is more conservative to state that available evidence indicates that sample group A is identified more with management than sample group B. The use of the word indicates actually is an understatement of the degree of confidence which should be placed on the interpretation.

The identification scale makes it possible to proceed with a tabulation of the scores for each person. This was accomplished by placing each subject's score on his respective summarized card. Several subject's total score could not be obtained because they did not answer all the questions that make up the scale. The cards were then segregated to the respective strata and the group means computed. The significance of mean differences is then expressed in terms of Fisher's t statistic (14).

IV. Methodology

The cards were separated into the following groups for analysis:

	Number
1. All participants	744
2. Sophomores	219
3. Seniors.	303
4. Engineers with less than five years service. . .	84
5. Engineers with more than five years service. . .	96
6. Engineers who belong to engineering societies. .	84
7. Engineers who do not belong to engineering societies.	96

For each of these groups and for every stratification, a mean value of the identification scores were computed. The identification score of an individual was determined by adding his responses to the seventeen questions that make up the identification index.

A comparison of the following groups has been made to determine their mean score differences and the significance of these differences:

1. Students versus engineers
2. Sophomores versus seniors
3. Sophomores versus engineers with less than five years service
4. Sophomores versus engineers with more than five years service
5. Seniors versus engineers with less than five years service
6. Seniors versus engineers with more than five years service
7. Engineers with less than five years service versus engineers with more than five years service
8. Engineers who belong to engineering society versus those who do not belong.

A bar graph comparison of group mean identification scores has been made to determine if any visible significance existed between:

1. Universities and colleges
2. Companies
3. Branch of engineering
4. General work classification

The final analysis has been made on item responses for all questions with comparison of stratified groups.

V. Results

A. Student engineers and non-supervisory engineers:

The null hypothesis is stated as --- there is no difference in the mean identification scores between engineering students and non-supervisory engineers. The mean identification scores of all students and non-supervisory engineers are shown in Table 5, page 34.

On the basis of these findings, it can be stated that we can reject the null hypothesis that there is no difference in the mean identification scores between engineering students and non-supervisory engineers. A t value of 2.367 gives approximately a two per cent level of confidence. Thus we see there is a decrease in the non-supervisory engineer's identification to management as compared to the engineering students.

B. The stages of maturity comparison for the non-supervisory engineer:

The statement that there is no difference in the mean identification scores between the stages of maturity of the non-supervisory engineer was investigated and tabulated in six combinations in Table 6, page 35. A F test was performed and the null hypothesis was rejected at the one per cent level of confidence. The analysis of variance showed an F value of 8.08. Thus the data indicates there is a difference

TABLE 5
STUDENT ENGINEERS VERSUS NON-SUPERVISORY ENGINEERS

Strata	Number	Mean Score	Sum of Scores	Sum of Squares	<u>t</u>
Students	522	40.54	21,161.9	891,699.6	2.367
Engineers	180	38.73	6,971.2	284,845.2	

TABLE 6

THE STAGES OF MATURITY COMPARISON FOR THE NON-SUPERVISORY
ENGINEER

Strata	Number	Mean Score	Sum of Scores	Sum of Squares	<u>t</u>
Sophomores	219	38.83	8,503.1	343,283.4	4.238
Seniors	303	41.78	12,658.8	548,415.5	
Sophomores	219	38.83	8,503.1	343,283.4	0.647
Less than 5 years	84	39.53	3,320.7	137,647.2	
Sophomores	219	38.83	8,503.1	343,283.4	0.733
More than 5 years	96	38.03	3,650.5	147,197.9	
Seniors	303	41.78	12,658.8	548,415.5	2.114
Less than 5 years	84	39.53	3,320.7	137,647.2	
Seniors	303	41.78	12,658.8	548,415.5	3.523
More than 5 years	96	38.03	3,650.5	147,197.9	
Less than 5 years	84	39.53	3,320.7	137,647.2	1.113
More than 5 years	96	38.03	3,650.5	147,197.9	

among the mean identification score at the various stages of maturity.

In comparing the sophomores and seniors for the universities, a t value of 4.238 was found. This is significant at the 0.1 per cent confidence level. Thus we can reject the null hypothesis that there is no change in self identification with management between sophomores and seniors. The seniors are more identified with management than are the sophomores.

In comparing the sophomore students and non-supervisory engineers with less than five years service it was found that there is practically no difference in identification with management. A t value of 0.65 gives approximately fifty-five per cent level of confidence. The slight decrease in identification of the engineer with less than five years service as compared to the sophomore is not significant, and the null hypothesis is accepted.

There is a decrease in self identification with management for the non-supervisory engineer with five or more years service as compared to the sophomore. A t value of 0.73 gives approximately fifty per cent level of confidence. This is again not significant, and the null hypothesis is accepted.

A t value of 2.11 gives a confidence level better than four per cent. Thus there is a decrease in identification with management of the non-supervisory engineer with less

than five years service as compared with seniors of today. The null hypothesis is rejected.

The non-supervisory engineer with more than five years service shows a larger decrease than the engineer with less than five years service as compared with the senior. The t value found gives a 0.1 per cent confidence level. We would be in error one time in one thousand by rejecting the null hypothesis that there is no difference between the average non-supervisory engineer with more than five years service and the average senior in our universities of today.

There is a decrease in identification for the non-supervisory engineer with more than five years service as compared to the non-supervisory engineer with less than five years service. It is not significant, however, because a t value of 1.11 is at the thirty per cent level of confidence. The null hypothesis is accepted that there is no difference in identification with management between the engineers with less than five and those with more than five years of service.

The sophomore students are found to have less identification with management than seniors; and non-supervisory engineers with five or more years of experience are found to have less identification with management than those with less than five years experience.

C. Engineers who belong to an engineering society versus those who do not belong:

Table 7, page 39, shows the identification mean scores on all non-supervisory engineers who do and who do not belong to an engineering society. The hypothesis is stated--- there is no difference in the mean identification score between those who do and those who do not belong to an engineering society.

On the basis of these findings, it can be stated that we can accept the null hypothesis. A t value of 0.59 gives a confidence level of approximately sixty per cent.

D. Comparison of Universities and Colleges by student's group mean identification scores:

The comparisons of the group means of students from one university to another can best be demonstrated by a bar graph as found in Figure 1, page 40.

Fifty survey forms were sent to each participating university and the N given represents the number of useable students from that university. The highest mean identification score is for number 1 with 48.88. The low score given shows some degree of identification with management as compared to a high degree of identification with management

TABLE 7
 BELONG VERSUS DO NOT BELONG TO ENGINEERING SOCIETY

Strata	Number	Mean Score	Sum of Scores	Sum of Squares	Critical Ratio- <u>t</u>
Do belong	84	39.16	3,289.1	135,567.1	0.587
Do not belong	96	38.36	3,682.1	149,278.1	

Univer- sity	N	Management identification mean scores							
		36	38	40	42	44	46	48	50
1	9	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 48.88							
2	19	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 43.91							
3	41	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 43.28							
4	45	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 42.64							
5	34	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 42.51							
6	29	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 41.91							
7	24	XXXXXXXXXXXXXXXXXXXXXXXXXXXX 41.13							
8	20	XXXXXXXXXXXXXXXXXXXX 40.46							
9	28	XXXXXXXXXXXXXXXXXXXX 40.41							
10	12	XXXXXXXXXXXXXXXXXXXX 40.40							
11	19	XXXXXXXXXXXXXXXXXXXX 40.20							
12	42	XXXXXXXXXXXXXXXXXXXX 39.81							
13	30	XXXXXXXXXXXXXXXXXXXX 39.73							
14	25	XXXXXXXXXXXXXXXXXXXX 39.53							
15	18	XXXXXXXXXXXX 38.94							
16	28	XXXXXXXXXXXX 38.88							
17	35	XXXXXXXXXXXX 38.24							
18	25	XXXXXXXXXXXX 38.00							
19	24	XXX 36.72							

Figure 1

COMPARISON OF UNIVERSITIES AND COLLEGES BY STUDENT'S
GROUP MEAN IDENTIFICATION SCORES

for the high score.

If this investigator was a recruiting officer for some concern desiring to hire engineers with other factors equal, my choice would be from a university which had engineering students showing a high degree of identification with management. This choice is based upon the attitudes and opinions that are incorporated within this scale which are extremely favorable toward industrial management philosophy. After hiring these new engineers, management policies could well be established to maintain this high degree of identification with management and prevent the gradual decrease in identification for the engineer as he gains experience.

E. Comparison of companies by non-supervisory engineer's group mean identification scores:

A similar comparison was made for the companies as shown in Figure 2, page 42. Code A represents stratified size of the company and is on the following page 43:.

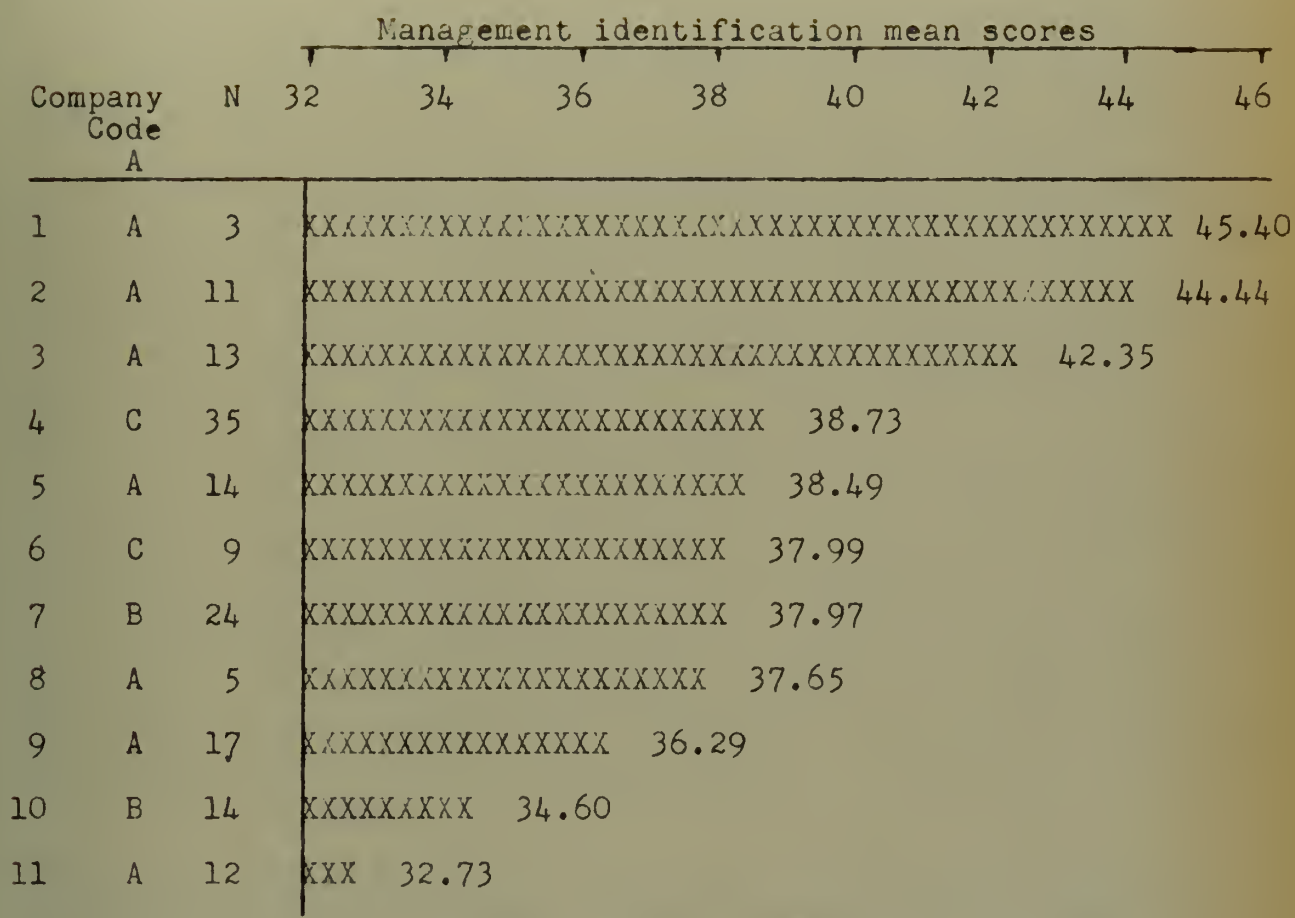


Figure 2

COMPARISON OF COMPANIES BY NON-SUPERVISORY ENGINEER'S
GROUP MEAN IDENTIFICATION SCORES

Code A

- A. . . Number of employees from 1,000 to 5,000
- B. . . Number of employees from 5,001 to 10,000
- C. . . Number of employees from 10,001 to 25,000

On the basis of these findings there is considerable variation in the identification scores between companies. In the smaller companies with less than 5,000 employed the variation ranges from high degree of identification with management to some degree of identification. For companies between 5,001 and less than 10,000 employed there is some degree of identification with management for the non-supervisory engineer. The two companies with over 10,001 employed have some degree of identification with management.

It appears that the variation could well be due to the labor relations policy set by management, and whether there is or is not a union within the company.

F. Comparison of group mean identification scores by branch of engineering in the field:

Figure 3, page 44, represents a comparison of the branch of engineering for the non-supervisory engineers in the field on an identification score basis.

The salient feature of this figure is the simple fact that, as the type of engineering branch deviates from pre-

		Management identification mean scores						
Engineering Branch	N	36	38	40	42	44	46	48
Inspection	5	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX						47.10
Production	7	XXXXXXXXXXXXXXXXXXXXXXXXXXXX						42.94
Industrial	16	XXXXXXXXXXXXXXXXXXXX						40.94
Other	14	XXXXXXXXXX						38.72
Design	83	XXXXXXXXXX						38.71
Test	11	XXXX						37.17
Research	45	XXX						36.86

Figure 3

COMPARISON OF GROUP MEAN IDENTIFICATION SCORES BY BRANCH
OF ENGINEERING IN THE FIELD

sumably non-supervisory engineer's contact with industrial workers, the less self identification with management becomes apparent. It was felt by this investigator that this may be true. We might interpret that the more authority and contact with industrial workers the branch of engineering has, the greater degree of self identification with management for the engineer within that branch.

G. Comparison of group mean identification scores by general work classification of engineers in the field:

Figure 4, page 46, represents a comparison for the general work classification of the non-supervisory engineers in the field. This figure admits some interesting comparisons, not only among the general work classifications, but with the overall variance. The variance in this classification is smaller than any of the previous investigations. It was predicted that industrial and mathematics would be high since the results found in Figure 3, page 44, for inspection, production, and industrial branch of engineering were high in identification with management.

Work Classifi- cation	N	Management identification mean scores						
		34	36	38	40	42	44	46
Industrial	22	XXXXXXXXXXXXXXXXXXXXXXX 41.47						
Mathematics	3	XXXXXXXXXXXXXXXXXXXXXXX 41.20						
Chemical	15	XXXXXXXXXXXXXXXXXXXXXXX 41.16						
Architectural	2	XXXXXXXXXXXXXXXXXXXXXXX 39.54						
Other	14	XXXXXXXXXXXXXXXXXXXXXXX 39.15						
Civil	7	XXXXXXXXXXXXXXXXXXXXXXX 38.33						
Mining	6	XXXXXXXXXXXXXXXXXXXXXXX 38.31						
Electrical	40	XXXXXXXXXXXXXXXXXXXXXXX 38.16						
Mechanical	54	XXXXXXXXXXXXXXXXXXXXXXX 37.73						
Aeronautical	19	XXXXXXXXXXXXXXX 36.99						

Figure 4

COMPARISON OF GROUP MEAN IDENTIFICATION SCORES BY GENERAL
WORK CLASSIFICATION OF ENGINEERS IN THE
FIELD

H. Data on all question responses:

Table 8, page 48 to 60, lists all responses to the questions given by the subjects. The first column of figures is based upon percentage of non-supervisory engineers answering that item of response. The second column of figures is based upon percentage of sophomore students. The third column of figures is for percentage of senior students endorsing that item response. The fourth column of figures is the percentage of engineers with less than three years service. The fifth column of figures is the percentage of engineers with three to five years of service. And the sixth column of figures is the percentage of engineers with five or more years service.

The non-supervisory engineers is based upon a total return of 186. The sophomores totaled 245 and the seniors totaled 314. The breakdown of the non-supervisory engineers is 32, 54, and 99, respectively.

In abiding by the law of parsimony, only the responses that are necessary to give a true and complete picture will be emphasized. Commenting on all responses would add volume to the report and do nothing that cannot be accomplished with fewer responses. The figures prior to the item responses are: The first column of figures is based on percentage of engineering students answering that item of response. The second column of figures is based on percentage of non-supervisory engineers. The third column of figures is based on percentage of total participants. These figures are listed on page 61 to 77.

TABLE 8
DATA ON ALL QUESTION RESPONSES

	% Engineers	% Sophomores	% Seniors	% Less than 3	% 3 to 5	% Over 5
6. What is your concept on how management views the relationship of the non-supervisory engineer to management?						
a.	8.6	9.4	10.8	12.5	9.3	7.1
b.	23.7	33.9	29.0	25.0	22.2	23.2
c.	37.1	30.6	28.7	28.1	42.6	37.4
d.	30.1	22.4	29.9	31.3	25.9	32.3
No answer	0.5	5.7	1.6	3.1	0.0	0.0
7. To what extent does the average non-supervisory engineer feel a sense of importance in his company?						
a.	2.9	4.5	4.5	6.3	1.9	6.1
b.	19.4	30.2	32.8	18.7	20.4	19.2
c.	56.1	54.7	53.5	53.1	57.4	49.5
d.	18.3	5.3	6.1	15.6	18.5	19.2
e.	2.2	0.0	0.3	3.1	1.9	5.1
No answer	1.1	5.3	2.9	3.1	0.0	1.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
8. How well do you think most engineers responsibilities are defined in their organization?						
a.	7.0	9.8	6.4	6.3	1.9	10.1
b.	64.5	71.0	71.3	62.5	72.2	60.6
c.	25.3	13.1	18.2	25.0	24.1	26.3
d.	3.2	1.2	1.6	6.3	1.9	3.0
No answer	0.0	4.9	2.5	0.0	0.0	0.0
9. To what degree do you feel that an engineer knows if his employer is satisfied with his work?						
a.	1.1	0.0	0.0	3.1	0.0	1.0
b.	27.9	11.0	10.2	15.6	35.2	28.3
c.	65.6	82.4	84.7	65.6	61.1	67.7
d.	4.3	3.7	3.5	9.4	3.7	3.0
No answer	1.1	2.9	1.6	6.3	0.0	0.0
10. To what extent do you feel that an engineer has personal freedom in his work situation?						
a.	2.9	1.6	2.9	3.1	3.7	6.1
b.	30.1	44.5	43.0	28.1	31.5	30.3
c.	61.3	50.2	52.2	59.4	63.0	60.6
d.	2.7	0.4	0.6	6.3	1.9	2.0
No answer	1.1	3.3	1.3	3.1	0.0	1.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
11. To what extent do you feel that an engineering background will qualify you for a supervisory or executive position?						
a.	24.7	28.2	37.3	34.4	24.1	22.2
b.	45.2	55.9	47.8	50.0	46.3	43.4
c.	25.8	12.7	11.1	15.6	25.9	29.3
d.	3.2	2.4	2.5	0.0	1.9	4.0
e.	0.5	0.0	1.3	0.0	0.0	1.0
No answer	0.5	0.8	0.0	0.0	1.9	0.0
12. To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?						
a.	3.8	11.4	10.2	3.1	3.7	4.0
b.	22.0	34.3	25.5	28.1	22.2	20.2
c.	23.7	22.0	21.0	28.1	20.4	23.2
d.	17.7	11.4	14.0	12.5	14.8	21.2
e.	11.8	8.6	10.2	3.1	20.4	10.1
f.	17.2	8.6	16.9	21.9	13.0	18.2
No answer	3.8	3.7	2.2	3.1	5.6	3.0

TABLE 8 CONTINUED

13. Rank in order which you feel will count most in your prospects for promotion.

Choice		Direct tally						
		a	b	c	d	e	f	g
1st	Sophomores	16	7	105	60	47	0	6
	Seniors	22	4	115	120	36	2	10
	Engineers	22	5	67	38	46	1	4
2nd	Sophomores	11	13	70	58	50	2	12
	Seniors	19	7	100	80	55	8	10
	Engineers	6	8	47	44	47	4	12
3rd	Sophomores	25	32	33	45	64	2	13
	Seniors	28	28	29	47	110	6	19
	Engineers	11	15	28	42	55	1	10
4th	Sophomores	32	71	8	29	32	17	22
	Seniors	51	77	20	17	40	14	48
	Engineers	24	35	13	25	8	6	42
5th	Sophomores	44	39	5	11	11	23	59
	Seniors	64	78	11	15	20	25	52
	Engineers	36	41	6	11	5	8	36
6th	Sophomores	47	25	2	13	4	49	57
	Seniors	53	40	8	7	14	60	67
	Engineers	29	29	3	5	3	42	20
7th	Sophomores	31	11	0	2	6	96	29
	Seniors	25	31	1	1	3	122	51
	Engineers	17	16	1	3	2	56	22

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
14. To secure and retain qualified engineers a company should pay						
a.	0.5	3.7	4.1	0.0	0.0	1.0
b.	43.5	42.4	45.5	46.9	38.9	45.5
c.	54.3	50.2	48.4	53.1	59.3	51.5
No answer	1.6	3.7	1.9	0.0	1.9	2.0
15. To what extent do companies have personnel policies differentiating between engineers and non-professional men?						
a.	15.1	3.3	5.4	6.3	22.2	14.1
b.	46.8	29.0	40.8	46.9	44.4	47.5
c.	35.5	53.5	44.3	46.9	31.5	34.3
d.	1.1	4.9	3.8	0.0	0.0	2.0
No answer	1.6	9.4	5.7	0.0	1.9	2.0
16. An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?						
a.	29.6	35.9	44.3	31.3	33.3	26.3
b.	31.7	36.3	27.4	28.1	35.2	31.3
c.	27.4	17.6	21.3	21.2	25.9	30.3
d.	3.2	4.1	2.5	9.4	0.0	3.0
e.	0.0	0.0	0.6	0.0	0.0	0.0
No answer	8.1	6.1	2.9	0.0	7.4	9.1

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
17. The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.						
a.	56.5	47.3	60.8	65.6	46.3	59.6
b.	28.0	33.9	27.7	25.0	33.3	25.3
c.	7.5	11.4	6.4	3.1	9.3	8.1
d.	7.5	6.5	5.1	6.3	11.1	6.1
No answer	0.5	0.8	0.0	0.0	0.0	1.0
18. How often are most engineers informed on company matters of interest and importance to them?						
a.	1.1	0.4	0.3	3.1	0.0	1.0
b.	14.0	3.3	4.1	12.5	20.4	11.1
c.	33.3	11.8	18.5	15.6	37.0	37.4
d.	45.7	65.7	65.3	59.4	38.9	44.4
e.	5.9	9.8	6.4	9.4	3.7	6.1
No answer	0.0	9.0	5.4	0.0	0.0	0.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
19. A company should distribute net profits						
a.	18.3	18.4	18.5	15.6	16.7	20.2
b.	31.2	33.5	30.6	37.5	42.6	22.2
c.	48.4	46.5	50.3	46.9	46.3	50.5
No answer	2.2	1.6	0.0	0.0	0.0	4.0
20. Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.						
a.	58.5	47.8	67.2	68.7	64.8	49.5
b.	70.5	65.3	74.5	81.3	68.5	67.7
c.	14.4	14.3	15.6	18.7	7.4	13.1
d.	34.5	26.5	39.8	40.6	29.6	38.4
e.	23.3	33.9	37.3	21.9	27.8	26.3
f.	65.6	59.2	70.4	62.5	74.1	62.6
g.	19.5	18.8	20.4	25.0	11.1	20.2
h.	52.9	45.7	60.5	59.4	42.6	50.5
i.	12.9	16.7	8.9	9.4	14.8	18.2
No answer	8.5	14.3	6.4	3.1	7.4	3.0

TABLE 8 CONTINUED

	Engineers	Sophomores	Seniors	Less than 3	3 to 5	Over 5
	%	%	%	%	%	%
21. Most companies have gone beyond the optimum point providing fringe benefits to employees.						
a.	13.4	11.4	10.5	3.1	18.5	14.1
b.	26.9	35.1	36.6	34.4	25.9	25.3
c.	41.4	35.5	35.7	37.5	48.1	39.4
d.	15.1	12.2	15.0	25.0	7.4	15.2
No answer	3.2	5.7	2.2	0.0	0.0	6.1
22. Personnel practices of most companies tend to maximize the contribution of their engineer personnel.						
a.	8.6	16.3	15.0	15.6	9.3	6.1
b.	31.2	46.5	47.8	34.4	33.3	28.3
c.	36.6	21.6	23.9	31.3	38.9	37.4
d.	19.9	6.9	10.2	18.7	11.1	25.3
No answer	2.2	8.6	3.2	0.0	7.4	3.0
23. A company should inform their employees as to the profits of the company.						
a.	61.8	55.9	57.0	68.7	51.9	64.6
b.	26.3	23.3	22.3	21.9	37.0	22.2
c.	5.4	9.0	11.8	6.3	3.7	6.1
d.	4.3	9.8	7.6	3.1	3.7	5.1
No answer	2.2	2.0	1.3	0.0	3.7	2.0

TABLE 8 CONTINUED

	Engineers	Sophomores	Seniors	Less than 3	3 to 5	Over 5
	%	%	%	%	%	%
24. Companies should promote engineers solely on basis of merit.						
a.	50.0	30.6	39.5	37.5	57.4	49.5
b.	37.1	36.7	33.8	40.6	37.0	36.4
c.	8.6	19.2	17.5	12.5	3.7	10.1
d.	3.2	12.2	8.9	9.4	0.0	3.0
No answer	1.1	1.2	0.3	0.0	1.9	1.0
25. How often do you feel you will (or) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?						
a.	19.9	5.7	7.0	18.7	22.2	19.2
b.	36.6	37.6	32.8	37.5	35.2	36.4
c.	32.3	44.9	49.0	31.3	37.0	30.3
d.	11.3	7.3	8.3	12.5	5.6	14.1
No answer	0.0	4.5	2.9	0.0	0.0	0.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
26. What do you feel is the chief deterring factor hindering engineers from becoming executives?						
a.	17.2	7.8	10.8	8.3	18.5	19.2
b.	13.4	7.8	10.2	5.6	20.4	12.1
c.	16.7	22.9	11.5	16.7	13.0	18.3
d.	38.8	47.9	56.4	58.3	46.3	36.3
e.	13.4	9.3	9.2	8.3	9.3	13.1
No answer	0.5	4.5	1.9	0.0	0.0	1.0
27. To what extent do most industrial unions encroach upon areas that should be reserved for management?						
a.	21.0	28.2	21.7	12.5	22.2	23.2
b.	65.6	62.4	71.6	71.9	68.5	61.6
c.	4.3	3.7	3.8	3.1	3.7	5.1
No answer	9.1	5.7	2.9	12.5	5.6	10.1

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
28. To what extent do you believe that companies are utilizing effectively the training and ability of the engineer.						
a.	1.1	0.4	1.3	0.0	1.9	1.0
b.	27.4	50.2	36.6	28.1	22.2	30.3
c.	48.4	34.7	47.5	53.1	50.0	46.5
d.	22.6	10.2	11.8	18.7	25.9	21.2
No answer	0.5	4.5	2.9	0.0	0.0	1.0
29. Most industrial non-supervisory workers are						
a.	1.1	1.2	0.6	0.0	0.0	2.0
b.	7.0	13.9	11.1	6.3	9.3	5.1
c.	59.1	55.1	54.1	62.5	55.6	60.6
d.	24.2	19.6	26.1	25.0	25.9	23.2
e.	2.9	2.4	1.0	3.1	5.6	5.1
No answer	2.2	7.8	3.8	3.1	3.7	4.0
30. In the long run an engineer can best further his economic objectives by:						
a.	23.7	32.7	30.6	28.1	25.9	20.2
b.	72.0	63.3	66.2	68.7	72.2	74.7
c.	3.2	2.4	1.6	3.1	0.0	4.0
No answer	1.1	1.6	1.6	0.0	1.9	1.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
31. As productivity and automation increases companies should grant their industrial workers a shorter work week without reducing take home pay.						
a.	25.8	22.4	27.7	21.9	24.1	27.3
b.	39.2	33.5	34.1	40.6	40.7	38.4
c.	21.5	26.1	23.2	18.7	16.7	25.3
d.	11.8	14.7	11.8	15.6	16.7	8.1
No answer	1.6	3.3	3.2	3.1	1.9	1.0
32. Most industrial non-supervisory workers are						
a.	2.2	3.3	0.6	6.3	1.9	2.0
b.	10.8	15.1	21.4	9.4	18.5	7.1
c.	56.5	57.1	64.3	56.3	42.6	64.6
d.	26.3	16.7	9.5	21.9	33.3	23.2
e.	1.1	0.8	0.3	3.1	1.9	0.0
No answer	3.1	6.9	3.8	6.3	1.9	3.0

TABLE 8 CONTINUED

	Engineers %	Sophomores %	Seniors %	Less than 3 %	3 to 5 %	Over 5 %
33. The effect of collective bargaining on advancement for those with a high degree of ability and initiative will						
a.	42.5	28.6	43.9	50.0	42.6	40.4
b.	36.0	41.2	38.9	28.1	38.9	36.4
c.	14.0	13.5	8.3	12.5	11.1	17.2
d.	5.9	9.8	4.8	9.4	5.6	4.0
e.	0.0	1.2	1.3	0.0	0.0	0.0
No answer	1.6	5.7	2.9	0.0	1.9	2.0
34. If an engineer has a personal problem or grievance it should be discussed and settled						
a.	71.5	50.2	63.4	78.1	77.8	65.7
b.	14.5	27.3	21.7	6.3	16.7	16.2
c.	6.5	8.6	9.5	9.4	0.0	9.1
d.	6.5	9.4	2.9	3.1	5.6	8.1
No answer	1.1	4.5	2.5	3.1	0.0	1.0
35. To what extent do you think the industrial policies within a company should be set by management or labor?						
a.	18.3	9.8	12.4	25.0	13.0	19.2
b.	78.0	81.2	83.8	71.9	87.0	74.7
c.	2.2	6.5	2.9	3.1	0.0	3.0
No answer	1.6	2.4	1.0	0.0	0.0	3.0

Question 6:

What is your concept on how management views the relationship of the non-supervisory engineer to management?

10.0%	8.6%	9.8%	a. part of the management team
31.0	23.7	29.3	b. a professional employee with authority and responsibility
29.4	37.1	31.4	c. an employee with delegated responsibility
26.4	30.1	27.5	d. an employee with technical duties
3.2	0.5	2.7	No answer

The population's concept is that most engineers and engineering students consider that management views them on the average as employees with delegated responsibility. It was thought that a greater percentage would consider themselves part of the management team. The seniors and the engineers with less than three years service are the only groups who are above the total average of 9.8 per cent for item response "a," and they have 10.8 and 12.5 per cent, respectively. There is a trend for seniors to have a more favorable outlook on how management views the relationship of the non-supervisory engineer to management than the sophomores and non-supervisory engineers.

Question 7:

To what extent does the average non-supervisory engineer feel a sense of importance in his company?

4.5%	2.9%	3.5%	a. very high degree of importance
31.6	19.4	28.6	b. high degree of importance
54.0	56.1	54.7	c. medium degree of importance
5.7	18.3	8.9	d. little degree of importance
0.2	2.2	1.1	e. very little degree of importance
4.0	1.1	3.2	No answer

The students indicate a greater degree of importance within his company than the engineers. There is a decrease in the feeling of importance for an engineer as he gains experience. The engineers with more than five years service have a normal distribution centered at medium degree of importance. The engineers with less than three years service show a distribution skewed to a greater degree of importance within his company. The engineers between three and five years service are skewed in the same direction, but not as much, as compared with the engineers with less than three years service. The engineers show an 18.3 per cent for "d," indicating a considerable difference in percentage over the 8.9 per cent for the total population.

Question 8:

How well do you think most engineers' responsibilities are defined in their organization?

7.9%	7.0%	7.7%	a. very well defined
71.2	64.5	69.5	b. defined on most matters
15.9	25.3	18.3	c. poorly defined
1.4	3.2	1.8	d. not defined
3.6	0.0	2.7	No answer

The findings indicate that the engineers' responsibilities are defined on most matters. Twenty-five per cent of the engineers choose poorly defined, which is approximately ten per cent more than either the sophomores or seniors endorsing this statement. This is a fair indication that the engineer's responsibilities could be better defined.

Question 9:

To what degree do you feel that an engineer knows whether his employer is satisfied with his work?

0.0%	1.1%	0.3%	a. he never knows
10.5	27.9	14.8	b. he seldom knows
83.7	65.6	79.2	c. he usually knows
3.6	4.3	3.8	d. he always knows
2.2	1.1	1.9	No answer

Eighty-three per cent of all students stated that the engineer usually knows whether his employer is satisfied with his work. However, the experienced engineers' opinions show a smaller percentage of sixty-five per cent. One out of every four of the engineers indicated that he seldom knows whether his employer is satisfied with his work.

Question 10:

To what extent do you feel that an engineer has personal freedom in his work situation?

2.3%	2.9%	2.9%	a. very little freedom
43.6	30.1	40.3	b. some freedom
51.4	61.3	53.8	c. considerable freedom
0.5	2.7	1.1	d. complete freedom
2.2	1.1	1.9	No answer

The students feel that the engineer has personal freedom in his work situation between some and considerable freedom. The engineers were more uniform through-out the stages of experience, and approximately 61 per cent said they had considerable freedom.

Question 11:

To what extent do you feel that an engineering background will qualify you for a supervisory or executive position?

33.3%	24.7%	31.1%	a. excellent possibility
51.4	45.2	49.8	b. above average possibility
11.8	25.8	15.3	c. average possibility
2.5	3.2	2.7	d. below average possibility
0.7	0.5	0.7	e. little possibility
0.3	0.5	0.4	No answer

Almost every third person thought it highly possible that an engineering background would qualify them for a supervisory or executive position. The order in which this feeling existed was: seniors, engineers with less than three years service, sophomores, engineers with between three and five years service, and engineers with more than five years service. The trend is an increase toward graduation and a corresponding decrease with years of service.

Question 12:

To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?.

10.7%	2.2%	9.0%	a. very advantageous
29.3	22.0	27.5	b. some advantage
21.5	23.7	22.0	c. very little advantage
12.9	17.7	14.1	d. no advantage
9.5	11.8	10.1	e. some disadvantage
13.2	17.2	14.2	f. considerable disadvantage
2.9	5.4	3.1	No answer

Better than 10 per cent of all students felt collective bargaining would be very advantageous for the engineer. Approximately one out of every three students and engineers with less than three years of service said it would be of some advantage. The engineers with more than three years service show a slight belief in some disadvantage of collective bargaining for engineers. The population concept shows that 58.5 per cent are in favor of responses "a, b, and c" and 24.3 per cent are in favor of responses "e and f". This indicates that most feel that collective bargaining would help the engineer. However, this is not a strong indication.

Question 13:

Rank in order which you feel will count most in your prospects for promotion.

5	6	5	a. who I know
4	5	4	b. length of service
1	1	1	c. amount of initiative
2	3	2	d. ability to secure cooperation of others
3	2	3	e. technical competence
7	7	7	f. social activities
6	4	6	g. conformity with accepted procedures and practices
8	8	8	h. other

A direct tallying indicated that the total population ranked as above what they thought counted most for promotion. The sophomores had an exact correspondence with this ranking. The seniors ranked as follows: first -- "d"; second -- "c"; third -- "e"; fourth -- "a"; fifth -- "b"; sixth -- "g"; and seventh -- "f".

Question 14:

To secure and retain qualified engineers a company should pay.

3.9%	0.5%	3.1%	a. low wage rate with many employee benefits
44.2	43.5	44.0	b. the going rate in the community
49.2	54.3	50.5	c. a high wage rate with few fringe benefits
2.7	1.6	2.4	No answer

Most of the students endorsed "b and c" in about equal amounts. The engineers showed a 54 per cent endorsement of a high wage rate with few fringe benefits. There is no trend apparent for the engineers and students on this question.

Question 15:

To what extent do companies have personnel policies differentiating between engineers and non-professional men?

4.5%	15.1%	7.1%	a. no differentiation
35.6	46.8	38.4	b. slight differentiation
48.3	35.5	45.1	c. considerable differentiation
4.3	1.1	3.5	d. complete differentiation
7.3	1.6	5.9	No answer

Most of the subjects stated that most companies have from slight to considerable differentiation between engineers and non-professional men. The greater the experience of an engineer the stronger was the feeling that there was slight differentiation in personnel policies. Sophomores indicated the strongest feeling that there was considerable differentiation, followed by seniors.

Question 16:

An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?

40.8%	29.6%	37.9%	a. will considerably minimize his opportunity
31.4	31.7	31.4	b. will somewhat minimize his opportunity
19.8	27.4	21.6	c. will not effect his opportunity
3.3	3.2	3.2	d. will somewhat increase his opportunity
0.4	0.0	0.3	e. will considerably increase his opportunity
4.3	8.1	5.6	No answer

Two out of every three subjects stated that an engineer who joins a union will somewhat to considerably minimize his opportunity to become an independent consultant. Forty per cent of the students indicated that he would considerably minimize his opportunities.

Question 17:

The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.

55.0%	56.5%	55.3%	a. agree
30.4	28.0	29.8	b. probably agree
8.6	7.5	8.3	c. probably disagree
5.7	7.5	6.2	d. disagree
0.3	0.5	0.4	No answer

It is generally agreed by all that the technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions. The seniors and engineers with less than three years of service showed a greater agreement than the others.

Question 18:

How often are most engineers informed on company matters of interest and importance to them?

0.3%	1.1%	0.5%	a. never
3.8	14.0	6.3	b. seldom
15.5	33.3	20.0	c. occasionally
65.5	45.7	60.5	d. usually
7.9	5.9	7.4	e. always
7.0	0.0	5.2	No answer

The students had over 65 per cent belief that the engineer is usually informed on company matters of interest and importance to him. The engineers had a definite trend towards "c," and better than 14 per cent choose "b," which is a significant difference from the population average.

Question 19:

A company should distribute net profits.

18.4%	18.3%	18.4%	a. to investors of the concern
31.9	31.2	31.7	b. to investors and employees at the company's discretion
48.6	48.4	48.6	c. to investors and employees on a definite basis
1.1	2.2	1.3	no answer

There was no visual trend apparent between the engineers and the engineering students on how a company should distribute net profits. The general feeling of every other participant was that they should be distributed to the investors and employees on a definite basis.

Question 20:

Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.

58.7%	58.5%	58.6%	a. professional status and prestige would be damaged
70.5	70.5	70.5	b. a "typing" of engineering positions and a "leveling" of salaries would result
15.0	14.4	14.8	c. The principles and practices of democracy would be enhanced in the engineers group relations with management
34.0	34.5	34.2	d. the principles and practices of democracy would be endangered in the engineers group relations with management
35.8	33.3	35.3	e. employment security would be increased
65.6	65.6	65.6	f. individual initiative would be restricted
19.7	19.5	19.6	g. reduce undesirable discriminatory treatment
54.0	52.9	53.9	h. individuals would be regimented by the union organization
12.3	12.9	12.5	i. economic standing would be improved
9.8	8.5	9.5	No answer

The variance among the groups is not as high as one would expect. In general item responses "a,b,f, and h" show unfavorableness towards the certification of a collective bargaining unit. For these four responses the groups endorsing them were in the following order ---- seniors, engineers with less than three years service, engineers with three to five years service, engineers with

more than five years service, and lastly, sophomores.

Fourteen per cent of the sophomores felt that they were not qualified to answer this question. It is generally noted that this population has an unfavorable attitude towards the certification of a collective bargaining unit. The item responses favorable to labor are "c,e,g and i." Of these, approximately 15 per cent of the population checked them, as compared with approximately 60 per cent checking the unfavorable responses to certification of collective bargaining.

Question 21:

Most companies have gone beyond the optimum point providing fringe benefits to employees.

10.9%	13.4%	11.5%	a. agree
36.0	26.9%	33.7%	b. probably agree
35.6	41.4	37.0	c. probably disagree
13.8	15.1	14.1	d. disagree
3.7	3.2	3.6	No answer

There is only a slight disagreement with this. The sophomores are neutral. The seniors and engineers tend to slightly disagree that most companies have gone beyond the optimum point providing fringe benefits to employees. This may indicate that most companies are approximately at the optimum point.

Question 22:

Personnel practices of most companies tend to maximize the contribution of their engineer personnel.

15.6%	8.6%	13.8%	a. agree
47.2	31.2	43.2	b. probably agree
22.9	36.6	26.3	c. probably disagree
8.8	19.9	11.5	d. disagree
5.5	2.2	5.1	No answer

Over 56 per cent of the engineers indicated a slight disagreement that most companies tend to maximize the contribution of their engineering personnel. Approximately 62 per cent of the students stated a slight agreement with this. It is apparent that the two groups have different feelings on what most companies' personnel practices are; in any case, the personnel practices seem to be adequate.

Question 23:

A company should inform its employees as to the profits of the company.

56.5%	61.8%	57.9%	a. agree
22.7	26.3	23.6	b. probably agree
10.6	5.4	9.3	c. probably disagree
8.6	4.3	7.5	d. disagree
1.6	2.2	1.7	No answer

There is almost complete agreement that a company should inform its employees as to the profits. The engineers agreed considerably more with this than did the students. In fact, the engineers with less than three years service agreed to the extent of better than 68 per cent stating agreement.

Question 24:

Companies should promote engineers solely on basis of merit

35.6%	50.0%	39.2%	a. agree
35.0	37.1	35.6	b. probably agree
18.3	8.6	15.8	c. probably disagree
10.4	3.2	8.6	d. disagree
0.7	1.1	0.8	No answer

Seven out of every eight engineers approved or probably approved of promoting engineers on basis of merit. Students did not agree as highly as the engineers in the field.

Their agreement or probable agreement was a little better than two out of every three. The engineers with service between three to five years were the strongest advocates of promoting on basis of merit, followed by the engineers with more than five years service.

Question 25:

How often do you feel you will (or do) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?

6.4%	10.9%	9.8%	a. seldom
34.9	36.6	35.3	b. occasionally
47.3	32.3	43.5	c. usually
7.8	11.3	8.7	d. always
3.6	0.0	2.7	No answer

The students had over 82 per cent endorsement on the response of occasionally and usually, with the sophomores giving about equal weight to each and the seniors tending toward usually. The engineers had a definite trend toward occasionally, and almost 20 per cent indicated they seldom had the opportunity to offer their ideas or suggestions when management decisions which fall within their job area are to be made. The breakdown by engineers showed no significant variations between them.

Question 26:

What do you feel is the chief deterring factor hindering engineers from becoming executives?

9.5%	17.2%	11.0%	a. difficulty in delegating authority and responsibility
9.1	13.4	9.9	b. limited effectiveness of getting results from others
16.6	16.7	16.6	c. inability to apply theoretical knowledge to practical managerial situations
52.7	38.8	50.3	d. inadequate leadership and human-relations skills
9.1	13.4	9.9	e. other
3.0	0.5	2.3	No answer

There is little significant variations in responses made by all groups except on response "d" --- inadequate leadership and human-relations skills. The seniors and engineers with less than three years service both endorsed this statement above 56 per cent each.

The comments that were made fell into several categories. One category was the simple answer of "none." Another was lack of training in business administration principles. A weakness commented by some was that the engineer is too specialized within a particular field. Others expressed lack of administrative and management training. This is an area in which companies can secure some knowledge of what the engineer thinks he needs training in to become an executive.

Question 27:

To what extent do most industrial unions encroach upon areas that should be reserved for management?

24.5%	21.0%	23.6%	a. in many areas of management responsibilities
67.6	65.6	67.1	b. in some areas of management responsibilities
3.8	4.3	3.9	c. in no areas of management responsibilities
4.1	9.1	5.4	No answer

The general consensus is that the unions do encroach upon some to many areas that should be reserved for management. The sophomore students certified over 28 per cent in many areas. The seniors and engineers with less than three years certified in some areas over 71 per cent.

Question 28:

To what extent do you believe that companies are utilizing effectively the training and ability of the engineer

0.9%	1.1%	0.9%	a. all of it
42.6	27.4	38.8	b. great portion of it
41.8	48.4	43.5	c. about half of it
11.1	22.6	14.0	d. small portion of it
3.6	0.5	2.8	No answer

Fifty per cent of the sophomore students indicated "b," that they believed that the companies utilize effectively the training and ability of the engineer. The seniors were also high on choice "b." Twenty-seven per cent of the engineers in the field believed a great portion of the training and ability of the engineers was being effectively utilized by the companies. This is just about half of the percentage for the sophomores. Almost one out of every four engineers expressed that the companies are utilizing a small portion of their training and ability. There is a definite tendency to responses "c and d" for the engineers as compared with students.

Question 29:

Most industrial non-supervisory workers are

0.9%	1.1%	0.9%	a. considerably overworked
12.3	7.0	11.0	b. somewhat overworked
56.4	59.1	57.1	c. neither overworked or underworked
23.2	24.2	23.5	d. somewhat underworked
1.6	2.9	2.4	e. considerably underworked
5.6	2.2	5.1	No answer

There was no considerable variation among the groups. Twenty-six per cent of the seniors stated that the industrial non-supervisory workers were somewhat underworked. The

majority felt that they were neither overworked nor underworked, and to a small extent somewhat underworked.

Question 30:

In the long run an engineer can best further his economic objectives by:

31.4%	23.7%	29.5%	a. doing his assigned work as efficiently as he knows how
65.0	72.0	66.7	b. perform assigned work adequately with constant attempts to assume greater responsibilities
2.0	3.2	2.3	c. join a collective bargaining union in demanding greater recognition of worth
1.6	1.1	1.5	No answer

Approximately every third student answered doing his assigned work as efficiently as he knows how, as compared with approximately every fourth engineer checking the same response. Approximately three out of every four engineers said an engineer should perform assigned work adequately, with constant attempts to assume greater responsibilities. A very small percentage of 2.3 stated that the engineer should join a collective bargaining union in demanding greater recognition of worth.

Question 31:

As productivity and automation increases companies should grant their industrial workers a shorter work week without reducing take home pay.

25.4%	25.8%	25.5%	a. agree
33.8	39.2	35.2	b. probably agree
24.5	21.5	23.8	c. probably disagree
13.1	11.8	12.8	d. disagree
3.2	1.6	2.8	No answer

Sixty-five per cent of the engineers agreed or probably agreed with the shorter work week. The variations

among the groups were small. The group that most agreed with a shorter work week were the engineers with more than five years service.

Question 32:

Most industrial non-supervisory workers are

1.8%	2.2%	1.9%	a. considerably overpaid
18.6	10.8	16.6	b. somewhat overpaid
61.2	56.5	60.0	c. neither overpaid or underpaid
12.7	26.3	16.1	d. somewhat underpaid
0.5	1.1	0.7	e. considerably underpaid
5.2	3.1	4.7	No answer

The responses gave a normal distribution, with all participants stating that most industrial non-supervisory workers are neither overpaid nor underpaid. The students varied to somewhat overpaid, and the engineers counteracted to make the normal distribution of all subjects by stating they were somewhat underpaid.

Question 33:

The effect of collective bargaining on advancement for those with a high degree of ability and initiative will

37.2%	42.5%	38.5%	a. reduce his opportunities considerably
30.9	36.0	38.9	b. reduce his opportunities somewhat
10.6	14.0	11.4	c. no effect on his opportunities
7.0	5.9	6.7	d. improve his opportunities somewhat
1.2	0.0	0.9	e. improve his opportunities considerably
4.1	1.6	3.5	No answer

Better than 67 per cent of the population believed it would somewhat to considerably reduce his opportunities in advancement. The engineers were more positive in this belief, with the group of engineers with three to five years experience having better than 81 per cent. The sophomores were the least receptive of responses "a and b."

Question 34:

If an engineer has a personal problem or grievance it should be discussed and settled

57.7%	71.5%	61.1%	a. by his supervisor
24.2	14.5	21.7	b. by a management panel
9.1	6.5	8.5	c. by formal grievance procedures
5.6	6.5	5.9	d. other
3.4	1.1	2.7	No answer

Over seventy-one per cent of the engineers thought that it should be settled by his supervisor, with engineers having three to five years service and engineers with less than three years service showing the greatest belief. The sophomores showed the least reception to "a" with 50 per cent, taking up the remaining percentage by checking "d" and leaving it blank.

The "others" given were generally statements such as "contact an outside person," "see the personnel advisor," or "discuss and settle with the supervisor's supervisor."

Question 35:

To what extent do you think the industrial policies within a company should be set by management or labor?

11.3%	18.3%	13.0%	a. it is the management's right to set all policies
82.6	78.0	81.5	b. decisions made by management with representation of labor on policies affecting employees directly
4.5	2.2	3.9	c. it is the labor's right to have joint determination on all policies
1.6	1.6	1.6	No answer

Most of the subjects feel that decisions on industrial policies should be made by management with representation of labor on policies affecting employees directly. Almost one

out of every five engineers felt it was the management's right to set all policies, with the engineers having less than three years service endorsing this response the most. A very small percentage of 3.9 per cent thought that it is the laborers' right to have joint determination on all policies.

Chapter V

DISCUSSION AND SUMMARY

I. Discussion

The findings of a study in judging the opinions of groups, made by R. M. TRAVERS (15) and reported in the Archives of Psychology, may enhance the validity of this scale in measuring identification with management. The study investigates the errors of an individual's judgment of group opinion on a set of statements. A specific issue is presented to an individual and he in turn is asked to estimate the percentage of the group that would agree with this statement. The validity of his judgment is then checked with the actual percentage given by the group. There were two types of groups -- one that the individual had contact with and knew, and one that he was not acquainted with. The findings were:

The errors of individual judgment of group opinion are on the average large. Judgments of group opinion on most issues with the groups studied were scattered over almost the entire scale from 0% to 100%. This occurred not only when the individuals were asked to judge the opinion of the group with whom they had been working but also when they were judging the national group. The judgments of group opinion were slightly less scattered in the case of the second group on account of the fact that the members of the group were better acquainted with each other.

Another investigation was performed by Hollingworth, in judging personality. This investigation showed that individual judgments of personality tend to have large errors, but the errors made by a number of judges tend to average zero.

Consequently, the average judgment of a number of judges of a well defined personality trait tends to be a fairly good estimate of the quantitative value of that trait.

Dr. Travers found a similar tendency in judging group opinions. The average of a number of judgments tends to be a fairly good estimate of the opinion of the group being judged. This is true in spite of the fact that individual judgments tend to be biased, since bias is canceled out when the performances of a number of individuals are added together and averaged.

Another investigation was conducted by Hinckley (16) on the influence of individual opinion on the construction of an Attitude Scale. One might think that the attitudes or feelings of the judges who are used in the construction of the scale would have an effect on the scale values obtained. In other words, it might be felt that one set of scale values for a series of statements might be obtained if the judges were, in general, favorable toward the company, while a different set of values might be obtained if the judges in general were unfavorable. This possibility has been subjected to experimental test by Dr. Hinckley, and it has been found that the attitudes of the judges do not significantly affect the scale values obtained from them.

With the support of these investigations it is felt that this scale measures what it was designed to measure, which is identification with management. Mature judges were asked to screen the statements that in their opinion

would measure the identity or affiliation of an engineer or student with management. The judges were not asked what management thinks is desirable for a particular situation. This is a field of study that some other investigator may pursue.

This investigation is for the specific purpose of determining extent to which an engineer identifies himself with management. In order to accomplish this, it is necessary to determine what the engineer thinks about specific situations in industry. It would be highly desirable to know how management thinks about these very same situations, and compare their opinions with those of non-supervisory engineers. This would require an equal number of survey forms to be sent to managers and engineers throughout the United States for a good statistical analysis. What the engineer thinks about the statements designed to discriminate his affiliation or non-affiliation with management will show his degree of identification with management.

The judges used in this investigation were not handicapped when asked to show whether the statement shows identification with management; for example, if the statement is:

As a non-supervisory engineer, I consider my position within a company as

- ☐ a. part of the management team
- ☐ b. another employee.

Certainly then if most of the judges rated the item response "a" as showing the individual's self identification with

management, a weighted value resulted. The judges placed their judgement on a well defined objective and provided an average score on each item response to make up a weighted scale that measures identification with management. It should be emphasized that the judges used were assisting in the construction of the scale, and not having their own attitude measured. All the statements that did not show seventy-five per cent agreement for measuring a person's self identification with management were rejected.

After the judging, the weighted scale was submitted to an internal consistency check to further check the validity. The internal consistency of the scale shows whether a statement really does measure the identification with management as the battery measures. It was found that all statements, except question number thirteen, which has the additional parameter of ranking, had been given properly assigned original numerical values. Eight questions were discarded because of their low differentiating power. The seventeen questions that make up the identification scale all have sufficient differentiating power to make up a reliable and valid scale.

When data is expressed in descriptive units, it is impossible to find means or relationships unless some technique is employed for reducing descriptive units to numerical units. The management identification scale provided this conversion. The questions were designed to

determine this identification. To accomplish this, many of the questions were upon issues that would show whether a person would identify himself with management at one extreme, with labor at the other extreme.

The analysis and interpretation of the data are more pressing preoccupations of this attitude survey. A thorough statistical analysis has been attempted for sound interpretations. Since the "facts" do not speak for themselves and a mere "counting" may not reveal the facts, the testing of hypothesis has aided in the interpretations.

The writer believes that the most important contribution of this study, besides the determination of the opinions and attitudes of non-supervisory engineers and students, is the technique used in developing the identification scale. It is hoped that others endeavoring to gain a weighted scale will further investigate the usefulness of this technique.

The identification scale provided discrimination of some participants with a score below twenty and others with a score above sixty. This range is from very little identification with management to almost complete identification. The scale showed that all participants had some degree of identification with management.

What are the implications of this identification? Does the engineer stand back and discuss in a detached manner the policies and decisions of management, or does he feel a part of management in helping to make these

policies and decisions with management. If the engineer persists in standing back, in a detached manner, then the engineer really does not consider himself part of the management team. This attitude on the part of the engineer is the result of either management's failure to spell out and make clear the objectives, policies and plans of management to the engineer, or the engineer's unwillingness to accept his responsibility as a member of the management team.

It is hoped that most engineering schools, recognizing that the engineering student is destined to take part in management, and having the information concerning their own students' identification, will institute a program to teach the fundamental principles of scientific management. This program might require all engineering students to take a course in leadership and human-relations skills.

II. Conclusions

The role of non-supervisory engineers in modern industry has changed in the last several decades. Some managements have taken steps to modify this role, but necessarily have done so with a minimum of factual information concerning it. The research reported here is designed to throw some light on the effect of a non-supervisory engineer's identification with management. Since the relationship between engineer and manager is by its very nature a changing and flexible affair, it is felt that

the hypotheses made on engineers-management relations has within it concepts adequate to deal with the dynamics of this relationship. A measure of management identification was developed for use in determining effects of the non-supervisory engineer's role in management.

The following findings are submitted:

1. The student engineers and non-supervisory engineers were compared to determine if a difference existed. There was a decrease in identification for the non-supervisory engineers which is significant at the five per cent level of confidence. At the five per cent level, this implies that the sample mean difference is so great that it would occur in less than five per cent of the samples from the population. A five per cent level of confidence was used in rejecting the null hypothesis, and therefore the null hypothesis is rejected.
2. The null hypothesis that there is no difference in the mean identification scores between the groups at the two stages of maturity of the non-supervisory engineer is rejected. A significant difference was found to exist between the sophomores and seniors, between seniors and engineers with less than five years service, and between seniors and engineers with more than five years service. The interpretation given to this significant difference is that there is a difference between the groups at various stages of maturity. Sophomore students are found to have

less identification with management than seniors; and non-supervisory engineers with five or more years of experience are found to have less identification with management than those with less than five years experience.

3. The non-supervisory engineers who belonged to an engineering society were compared with those who do not belong, to determine whether any difference in identification existed. There was a greater identification for those who belonged to an engineering society, but at the sixty per cent level of confidence the null hypothesis was accepted.

4. It was found that in our universities there was considerable variations in the student's self-identification with management.

5. It was found that considerable variations in self-identification with management for the non-supervisory engineer existed for the companies.

6. In the comparison of branch of engineering relative to identification, it was found that inspection, production and industrial branches were higher than the others. A suggested interpretation is that the more authority and contact with industrial workers the branch of engineering has, the greater the degree of self identification with management for the engineer within that branch.

7. In comparing non-supervisory engineers in their general work classifications it was found that industrial, mathematics and chemical, had a high degree of identification with management.

The findings, regarding data on all questions, are submitted and may be located on page 61 to page 77.

When the engineer's slide rule is joined by the latest and most practical findings on human motivation and behavior, when the engineer can use both tools to solve executive problems as needed, then we will have a competent corps of engineers to fill the billets of industrial management.

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APPENDIX A
SAMPLE COPY OF LETTER AND POSTCARD TO
INVOLVE PARTICIPATION

12 February 1955

Mr. J. K. Barnes, Jr.
Director of Public Relations
Carrier Corporation
300 South Geddes Street
Syracuse 1, New York

Dear Sir:

There has been some contention during recent years that the attitudes and opinions of students and employed engineers have undergone some marked changes in regards to their engineering profession and work situations. In this respect we propose to measure the degree of management orientation of an extended sample of engineers in industry who have been working for a number of years, also engineering students at the sophomore and senior level in our major universities.

We anticipate that you will be interested in receiving the results of this study, if so, kindly check the enclosed card indicating that you will cooperate in the distribution of our survey sheet. In that event you will soon receive a few survey forms for distribution depending on the size of your organization.

The forms will carry complete instructions and will be stamped and addressed for return. The identity of all participants will remain strictly anonymous though each organization will receive information showing a comparison of their situation with other organizations.

This project is being undertaken as a graduate thesis and must be completed this semester. Will you kindly check the enclosed card and drop it in the mail today?

Sincerely yours,

Ralph E. Balyeat
Supervisor of Industrial Relations Courses
Industrial Engineering Department
Purdue University

POSTCARD SAMPLE

We will participate in administering the
survey that you furnish - - - - - ☐

We prefer not to participate- - - - - ☐

Communications and survey should be addressed to:

Name _____ Title _____

Company _____

Address _____

Suggestions or Comments:

APPENDIX B
SET OF INSTRUCTIONS AND LETTER OF
TRANSMITTAL FOR ADMINISTERING THE
QUESTIONNAIRE

SUGGESTED METHODS OF DISTRIBUTION WITHIN A UNIVERSITY OR COLLEGE:

The following suggestions are listed in descending order of preferable methods of distribution. Please choose the method that you can most effectively accomplish.

1. Select four engineering classes with two classes predominately seniors and graduate students and the other two classes predominately sophomores. Issue approximately one fourth of the survey forms to each professor in charge of these classes. Instruct the professors to distribute the survey forms by systematic sampling --- such as selecting a random number between 1 and 10, and taking the engineering student seated in the position indicated by this number and every nth student thereafter until the forms are distributed.

2. Select several faculty members that instruct sophomores and senior engineering students. Distribute survey forms in equal number to selected faculty members. Instruct the faculty member to randomly distribute one half of his proportion to sophomores and the other half to senior engineering students.

3. Distribute in any random order that you desire by issuing one half of the forms to sophomores and the other half to senior engineering students.

Please instruct professors involved not to discuss the survey or the survey forms prior to filling in the questionnaire by the student.

SUGGESTED METHODS OF DISTRIBUTION WITHIN A COMPANY:

The following suggestions are listed in descending order of preferable methods of distribution. Please choose the method that you can most effectively accomplish.

1. a. If engineers are in one department:
Make two lists of non-supervisory engineers, the first showing those with less than five years service and the second showing those with over five years service. Number the engineers in each list. Divide the number of engineers in each by one half of the number of forms received by you. The whole number obtained will show the distribution ratio for each group. For example, if the distribution ratio is 4.1 --- give a form to each 4th engineer on your list until they are distributed.
- b. If engineers are in more than one department:
Distribute a proportional number of survey forms to the departments involved. Instruct the department to issue their proportion as in (a) above.
2. Distribute in any random order that you desire by issuing one half of the forms to non-supervisory engineers with less than five years service and the other half to those with over five years.
3. Distribute in a random manner by giving a form to every 3rd, 4th, or 5th, etc., non-supervisory engineer at their work stations until all forms are issued.

PURDUE UNIVERSITY
Department of General Engineering
Lafayette, Indiana

16 March 1955

(Heading)

Dear Mr. Smith

Please accept my thanks for your prompt return of the postcard indicating your willingness to participate in the management orientation and attitude survey of non-supervisory engineers and engineering students.

Enclosed you will find eighty two survey forms together with suggested procedures for their distribution. The prompt distribution of these forms will certainly help in completing the project as scheduled. You will receive a summary of the results as soon as the returns are tabulated and analyzed.

Thanking you again for your cooperation and prompt attention, I remain

Ralph E. Balyeat
Supervisor of Industrial Relations Courses
Industrial Engineering Department
Purdue University

APPENDIX C
COPY OF THE ATTITUDE SURVEY
QUESTIONNAIRE

OPINION SURVEY
NON-SUPERVISORY ENGINEERS & ENGINEERING STUDENTS

WE WOULD APPRECIATE YOUR COOPERATION IN THIS
GRADUATE THESIS PROJECT.

Have you ever wondered how your attitudes towards various industrial practices and policies compared with those of your fellow professional employees? Participation in this project may provide your answer as the results will be published. In addition, it will materially aid the preparation of course material developed to assist engineering students in obtaining the maximum degree of job satisfaction from future work situations.

Please ✓ the statement, which most nearly expresses your viewpoint. This will be interpreted as being an approximate rather than an exact expression of your attitude.

POINTS TO KEEP IN MIND:

1. YOUR ANSWERS WILL BE KEPT CONFIDENTIAL. Do not sign your name. The answers you give in the first five questions will help us to get group opinion summaries, but will in no way identify you.

2. NO SUPERVISOR OR EMPLOYER WILL SEE YOUR FILLED IN OPINIONS. After your answers are tabulated at Purdue University, the forms will be destroyed.

3. THE STUDY MUST BE COMPLETED THIS SEMESTER. Will you please fill in and mail immediately

4. THIS IS NOT A RATING DEVICE, NOR IS IT A TEST. There are no "right" or "wrong" answers. Please try to answer every question, but if you feel you can't answer some, then answer the others and mail your form anyway

5. WE WOULD LIKE YOUR FRANK AND HONEST OPINION. This study is going to Engineers in the field and to students in our universities. Please do not talk over the questions with others -- just indicate what you think. Should you desire to make any comments, feel free to do so.

6. IN SUMMARY, THEN, PLEASE

1. Fill out the form honestly, to the best of your ability.
2. Fold and mail promptly.

Your cooperation in filling out and returning this Opinion Form immediately will be very much appreciated.

RALPH E. BALYEAT
Supervisor of Industrial Relations Courses
Industrial Engineering Department
Purdue University

1. College - Attending _____ Sophomore _____ Senior _____
Graduate from _____ Year Graduated _____
2. Company if employed _____
Years of engineering experience: under 1 _____ 1-3 _____ 3-5 _____ over 5 _____
3. Check your branch of engineering:
Civil _____ Chemical _____ Industrial _____ Mech. _____ Elect. _____ Other _____
4. Are you a member of one or more of the engineering societies? Yes _____ No _____
5. If employed, general work classification:

_____ Research	_____ Production	_____ Industrial
_____ Design	_____ Test	_____ Inspection
_____ Estimating	_____ Detailing	_____ Other _____
6. What is your concept on how management views the relationship of the non-supervisory engineer to management?
 _____ a. part of the management team?
 _____ b. a professional employee with authority and responsibility?
 _____ c. an employee with delegated responsibility?
 _____ d. an employee with technical duties?
7. To what extent does the average non-supervisory engineer feel a sense of importance in his company?
 _____ a. very high degree of importance
 _____ b. high degree of importance
 _____ c. medium degree of importance
 _____ d. little degree of importance
 _____ e. very little degree of importance
8. How well do you think most engineers responsibilities are defined in their organization?
 _____ a. very well defined
 _____ b. defined on most matters
 _____ c. poorly defined
 _____ d. not defined
9. To what degree do you feel that an engineer knows if his employer is satisfied with his work?
 _____ a. he never knows
 _____ b. he seldom knows
 _____ c. he usually knows
 _____ d. he always knows
10. To what extent do you feel that an engineer has personal freedom in his work situation?
 _____ a. very little freedom
 _____ b. some freedom
 _____ c. considerable freedom
 _____ d. complete freedom
11. To what extent do you feel that an engineering background will qualify you for a supervisory or executive position?
 _____ a. excellent possibility
 _____ b. above average possibility
 _____ c. average possibility
 _____ d. below average possibility
 _____ e. little possibility
12. To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?
 _____ a. very advantageous
 _____ b. some advantage
 _____ c. very little advantage
 _____ d. no advantage
 _____ e. some disadvantage
 _____ f. considerable disadvantage
13. Rank in order which you feel will count most in your prospects for promotion.
 _____ a. who I know
 _____ b. length of service
 _____ c. amount of initiative
 _____ d. ability to secure cooperation of others
 _____ e. technical competence
 _____ f. social activities
 _____ g. conformity with accepted procedures and practices
 _____ h. other
14. To secure and retain qualified engineers a company should pay.
 _____ a. a low wage rate with many employee benefits
 _____ b. the going rate in the community
 _____ c. a high wage rate with few fringe benefits

15. To what extent do companies have personnel policies differentiating between engineers and non-professional men?
 _____ a. no differentiation
 _____ b. slight differentiation
 _____ c. considerable differentiation
 _____ d. complete differentiation
16. An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?
 _____ a. will considerably minimize his opportunity
 _____ b. will somewhat minimize his opportunity
 _____ c. will not effect his opportunity
 _____ d. will somewhat increase his opportunity
 _____ e. will considerably increase his opportunity
17. The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
18. How often are most engineers informed on company matters of interest and importance to them?
 _____ a. never
 _____ b. seldom
 _____ c. occasionally
 _____ d. usually
 _____ e. always
19. A company should distribute net profits.
 _____ a. to investors of the concern
 _____ b. to investors and employees at the company's discretion
 _____ c. to investors and employees on a definite basis
20. Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.
 _____ a. professional status and prestige would be damaged
 _____ b. a "typing" of engineering positions and a "levelling" of salaries would result
 _____ c. the principles and practices of democracy would be enhanced in the engineers group relations with management
 _____ d. the principles and practices of democracy would be endangered in the engineers group relations with management
 _____ e. employment security would be increased
 _____ f. individual initiative would be restricted
 _____ g. reduce undesirable discriminatory treatment
 _____ h. individuals would be regimented by the union organization
 _____ i. economic standing would be improved
 _____ j. other
21. Most companies have gone beyond the optimum point providing fringe benefits to employees.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
22. Personnel practices of most companies tend to maximize the contribution of their engineer personnel.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
23. A company should inform their employees as to the profits of the company.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
24. Companies should promote engineers solely on basis of merit.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
25. How often do you feel you will (or) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?
 _____ a. seldom
 _____ b. occasionally
 _____ c. usually
 _____ d. always
26. What do you feel is the chief deterring factor hindering engineers from becoming executives?
 _____ a. difficulty in delegating authority and responsibility
 _____ b. limited effectiveness of getting results from others
 _____ c. inability to apply theoretical knowledge to practical managerial situations
 _____ d. inadequate leadership and human-relations skills
 _____ e. other

27. To what extent do most industrial unions encroach upon areas that should be reserved for management?
 _____ a. in many areas of management responsibilities
 _____ b. in some areas of management responsibilities
 _____ c. in no areas of management responsibilities
28. To what extent do you believe that companies are utilizing effectively the training and ability of the engineer.
 _____ a. all of it
 _____ b. great portion of it
 _____ c. about half of it
 _____ d. small portion of it
29. Most industrial non-supervisory workers are.
 _____ a. considerably overworked
 _____ b. somewhat overworked
 _____ c. neither overworked or underworked
 _____ d. somewhat underworked
 _____ e. considerably underworked
30. In the long run an engineer can best further his economic objectives by:
 _____ a. doing his assigned work as efficiently as he knows how
 _____ b. perform assigned work adequately with constant attempts to assume greater responsibilities.
 _____ c. join a collective bargaining union in demanding greater recognition of worth
- fold 31. As productivity and automation increases companies should grant their industrial workers a shorter work week without reducing take home pay.
 _____ a. agree
 _____ b. probably agree
 _____ c. probably disagree
 _____ d. disagree
32. Most industrial non-supervisory workers are:
 _____ a. considerably overpaid
 _____ b. somewhat overpaid
 _____ c. neither overpaid or underpaid
 _____ d. somewhat underpaid
 _____ e. considerably underpaid
33. The effect of collective bargaining on advancement for those with a high degree of ability and initiative will:
 _____ a. reduce his opportunities considerably
 _____ b. reduce his opportunities somewhat
 _____ c. no effect on his opportunities
 _____ d. improve his opportunities somewhat
 _____ e. improve his opportunities considerably
34. If an engineer has a personal problem or grievance it should be discussed and settled:
 _____ a. by his supervisor
 _____ b. by a management panel
 _____ c. by formal grievance procedures
 _____ d. other _____
35. To what extent do you think the industrial policies within a company should be set by management or labor?
 _____ a. it is the management's right to set all policies
 _____ b. decisions made by management with representation of labor on policies affecting employees directly
 _____ c. it is the labor's right to have joint determination on all policies
- fold



Professor Ralph E. Balyeat,
 Supervisor of Industrial Relations Courses
 Industrial Engineering Department
 Purdue University
 Lafayette, Indiana

APPENDIX D
ITEM ANALYSIS INSTRUCTIONS

Identification Scale Development

This is the initial step to obtain a scale that will provide Universities and Companies with an insight regarding the non-supervisory engineer's identification with management. Your cooperation is asked in the development of this scale.

Included is a form being used to determine management orientation of an engineering student or non-supervisory engineer. The first five questions are used for stratification and are to be disregarded. There are two steps to be followed. The first step is the initial selection of items and the second is screening of item responses. Please follow the below instructions carefully.

Initial Selection of Items

Not all of the items in this questionnaire can be presumed to be of value in measuring the management orientation of an engineer or student. In order to remove these non-valid items from the proposed scale, please place a no before the question that you feel does not measure the identity or affiliation of an engineer or student with management. A helpful thought that may aid you in this screening is whether the question will differentiate the non-supervisory engineer or student between pro-management or pro-labor.

Screening of Item Responses

For the questions that you have indicated will show a measurement of identification, please indicate by code number the degree that you feel each response to the question will provide. Use the following code and place the code number before the response.

<u>Code</u>	<u>Rating</u>
4. . .	Complete identification with management
3. . .	High degree of identification with management
2. . .	Some degree of identification with management
1. . .	Very little degree of identification with management
0. . .	No identification with management

If you feel two responses each show the same degree of management identification, indicate by placing the same code number before each. For example:

77. $\frac{0}{0}$ a. $\frac{3}{2}$ d.
 $\frac{1}{1}$ b. e.
 c.

Your cooperation is greatly appreciated.

APPENDIX E
PARTICIPATING UNIVERSITIES

PARTICIPATING UNIVERSITIES

Purdue University
University of Massachusetts
Ohio State University
University of Minnesota
University of Florida
Michigan State College
Rutgers University
University of Colorado
Oklahoma A. and M. College
University of Washington
Pennsylvania State College
Iowa State College
North Carolina State College
Northwestern University
University of Michigan
New York University
University of Kansas
University of Buffalo
George Washington University

APPENDIX F
PARTICIPATING COMPANIES

PARTICIPATING COMPANIES

Champion Paper & Fibre Co.

Newport Steel Corp.

Bell & Howell Co.

Potash Co. of America

McDonnell Aircraft Corp.

Eaton Mfr. Co.

Beech Aircraft Corp.

Ball Bros. Co., Inc.

Naval Ordnance Plant Indianapolis

Rohr Aircraft Corp.

Cook Electric Co.

APPENDIX G

CRITERION OF INTERNAL CONSISTENCY APPLIED TO THE
IDENTIFICATION SCALE

CRITERION OF INTERNAL CONSISTENCY APPLIED TO THE IDENTIFICATION SCALE
(Random sample of 200 subjects)

High Cases	Statement Numbers												21	22
	6	7	10	11	12	13	15	16	17	18	19	20		
1.	2.82	3.00	1.06	3.94	3.68	2.94	0.94	3.62	3.06	2.61	3.28	14.55	2.88	2.25
2.	2.82	3.00	2.38	3.94	1.82	0.88	2.50	3.62	3.06	3.67	3.28	14.32	0.00	2.94
3.	2.82	1.88	2.38	2.94	3.68	2.69	2.50	3.62	3.06	2.61	3.28	11.55	2.88	0.50
4.	2.82	3.00	1.06	3.94	0.05	2.94	2.50	3.62	3.06	3.67	0.78	11.64	1.76	2.25
5.	0.32	1.88	2.38	3.94	2.77	2.94	0.11	2.10	3.06	1.28	3.28	14.32	1.76	2.25
6.	1.41	1.88	1.06	2.94	0.05	2.94	2.50	3.62	1.88	2.61	2.39	14.32	1.76	2.25
7.	1.41	1.88	2.38	2.94	3.68	2.94	2.50	3.62	3.06	3.67	0.78	14.32		2.25
8.	1.41	3.88	2.38	3.94	3.68	3.06	0.11	0.67	3.06	2.61	2.39	14.32		2.25
9.	3.86	3.00	2.38	3.94	3.68	3.06	2.50	2.10	3.06	2.61	2.39	8.87	1.76	2.25
10.	0.32	1.88	2.38	1.69	1.82	2.69	2.50	3.62	1.88	2.61	3.28	14.32	1.76	2.25
11.	2.82	3.00	2.38	3.94	3.68	2.94	2.50	3.62	1.88	2.61	2.39	8.41	1.76	2.25
12.	2.82	3.00	2.38	2.94	0.05	2.94	0.94	3.62	0.06	1.28	2.39	14.32	2.82	2.25
13.	2.82	3.00	2.38	1.69	1.82	0.88	2.50	3.62	3.06	2.61	3.28	12.19	0.47	2.25
14.	1.41	1.88	0.19	1.69	3.68	2.69	2.50	3.62	3.06	1.28		14.32	1.76	0.50
15.	1.41	3.88	2.38	3.94	3.68	0.88	2.50	3.62	3.06	2.61	3.28	14.55	2.88	2.25
16.	2.82	3.00	2.38	3.94	3.68	2.94	2.50	3.62	3.06	2.61	0.78	14.32	0.47	2.94
17.	3.86	1.88	2.38	3.94	2.77	3.06	0.94	3.62	3.06	2.61	0.78	11.59	0.47	2.25
18.	2.82	3.88	2.38	3.94	1.82	2.94	2.50	2.10	3.06	2.61	2.39	14.32	0.47	2.25
19.	0.32	1.88	2.38	3.94	1.82	0.77	2.50	3.62	1.88	2.61	3.28	14.32	1.76	2.25
20.	0.32	3.00	2.38	2.94	0.00	3.06	0.94	0.67	3.06	2.61	3.28	14.55	1.76	2.94
Sum	41.43	53.68	41.45	67.05	47.91	50.16	38.98	61.94	53.48	51.39	46.98	265.42	29.18	43.57

INTERNAL CONSISTENCY CONTINUED

High Cases	23	24	25	27	28	29	30	31	33	34	35	Total Score
1.	.	3.82	1.32	3.57	2.71	1.79	2.36	0.69	3.23	2.70	3.82	77.39
2.	.	0.69	3.77	3.57	2.71	1.21	2.36	2.88	2.50	2.70	2.09	72.77
3.	.	0.75	2.73	3.57	1.41	1.79	2.82	1.88	3.23	2.70	3.82	74.91
4.	.	0.69	2.73	3.57	2.71	1.79	2.82	0.69	3.23	0.10	3.82	69.06
5.	.	0.75	1.32	3.57	2.71	1.21	2.82	0.56	2.50	2.70	3.82	68.06
6.	.	0.69	2.73	3.57	2.71	1.21	2.36	1.88	2.50	2.70	2.09	68.17
7.	.	0.69	2.73	3.57	1.41	1.79	2.82	0.69	3.23	2.70	2.09	67.87
8.	.	0.69	2.73	2.05	2.71	1.21	2.82	2.88	3.23	2.70	2.09	69.91
9.	.	0.69	3.77	3.57	0.24	1.79	2.82	0.56	3.23	2.00	3.82	70.69
10.	.	2.63	1.32	2.05	1.41	1.79	2.82	2.88	2.50	2.00	2.09	71.77
11.	.	0.75	1.32	2.05	2.71	1.21	2.36	0.69	2.50	2.70	3.82	68.31
12.	.	0.75	2.73	2.05	2.71	1.21	2.82	2.88	3.23	2.70	2.09	68.86
13.	.	0.69	1.32	2.05	2.71	1.21	2.82	2.88	3.23	2.70	3.82	69.72
14.	.	1.69	3.77	3.57	0.24	1.79	2.36	1.88	3.23	2.70	3.82	67.45
15.	.	2.63	3.77	3.57	2.71	1.79	2.36	0.56	3.23	2.70	2.09	76.51
16.	.	0.69	2.73	2.05	2.71	1.21	2.82	0.69	3.23	2.00	2.09	73.10
17.	.	0.69	2.73	2.05	1.41	1.21	2.82	0.56	3.23	2.70	3.82	69.16
18.	.	0.69	2.73	2.05	1.41	0.58	2.82	0.69	2.50	2.70	2.09	69.56
19.	.	0.75	2.73	3.57	1.41	1.21	2.36	2.88	3.23	2.70	2.09	69.00
20.	.	0.69	2.73	3.57	0.24	1.21	2.82	0.56	3.23	2.70	3.82	66.90
Sum Hi	19.04	70.52	51.71	59.24	38.99	28.21	53.18	29.86	60.22	49.30	59.10	

INTERNAL CONSISTENCY CONTINUED

Low Cases	Statement Number																20	21	22
	6	7	10	11	12	13	15	16	17	18	19								
1.	0.32	1.88	2.38	2.94	0.05	2.94	0.94	0.67	3.06	1.28	0.78	1.76	0.50						
2.	0.32		1.06	2.94	0.05	2.94	0.94	2.10	1.88	1.28	3.28	1.76	0.50						
3.	1.41	0.76	1.06	2.94	0.05	3.06	2.50	0.67	0.29	1.28	0.78	1.76	0.50						
4.	0.32	1.88	0.19	3.94	0.05	2.69	0.11	0.19	3.06	3.67	0.78	0.00	0.50						
5.	2.82	1.88	2.38	3.94	0.05	2.94	0.94	0.67	0.06	2.61	0.78	0.00	0.31						
6.	1.41	1.88	2.38	2.94	0.05	2.69	0.94		3.06	1.28	0.78	0.00	0.31						
7.	1.41	1.88	1.06	1.69	0.05	2.69	0.94	2.10	1.88	2.61	0.78	1.76	2.25						
8.	1.41	1.88	2.38	2.94	0.05	2.69	0.94	2.10	3.06	1.28	0.78	0.00	0.50						
9.	1.41	0.76	2.38	2.94	0.00	2.94	0.94	0.67	3.06	2.61	0.78	0.47	0.50						
10.	1.41	0.76	1.06	2.94	0.55	3.06	0.94	2.10	3.06	1.28	0.78	0.47	0.50						
11.	0.32	1.88	1.06	2.94	0.05	2.69	2.50	3.62	0.06	0.17	0.78	0.00	0.31						
12.	0.32	0.76	2.38	2.94	0.05	2.94	0.11	0.67	1.88	1.28	0.78	0.00	0.31						
13.	0.32	0.76	2.38	2.94	0.55	2.94	0.94	0.67	0.06	2.61	2.39	0.00	0.31						
14.	0.32	1.88	2.38	2.94	0.55	2.94		0.67	1.88	1.28	0.78	0.00	0.50						
15.	0.32	3.00	2.38	3.94	0.05	3.06	0.94	0.67	3.06	2.61	3.28	0.47	0.50						
16.	2.82	3.00	1.06	1.69	1.82	2.94	2.50	0.67	0.29	3.67	0.78	1.76	0.31						
17.	1.41	1.88	2.38	2.94	0.55	3.06	0.94	2.10	0.06	1.28	2.39	0.47	0.31						
18.	2.82	0.76	2.38	3.94	0.05	2.94	2.50	0.67	1.88	2.61	0.78	0.47	0.50						
19.	2.82	1.88	2.38	2.94	0.05	1.31	0.94	2.10	1.88	2.61	0.78	0.47	0.50						
20.	0.32	1.88	2.38	3.94	0.05	3.06	0.94	2.10	1.88	2.61	0.78	0.47	0.50						
Sum Low	24.03	31.24	37.49	61.30	4.62	56.77	22.44	25.21	35.40	39.91	23.82	56.54	12.09	9.42					

INTERNAL CONSISTENCY CONTINUED

Low Cases	Statement Number										Total	
	23	24	25	27	28	29	30	31	33	34	35	Score
1.	.	2.76	0.32	3.57	1.41	1.79	2.36	1.88	0.91		2.09	37.23
2.	.	0.75	2.73	2.05	2.71	1.21	2.82	0.69	2.50		2.09	43.22
3.	.	0.75	1.32	2.05	2.71	1.79	2.82	0.69	0.91	2.70	2.09	43.47
4.	.	0.69	3.82	2.05	1.41	1.21	2.36	0.56	3.23	0.10	2.09	43.68
5.	.	2.63	0.06	2.05	2.71	1.21	2.36	2.88	0.00	2.70	2.09	40.80
6.	.	0.69	2.76	3.57	0.24	0.58	0.00	1.88	3.23	0.10	2.09	33.96
7.	.	0.69	0.71	2.05	2.71	1.21	2.82	0.56	0.91	2.70	2.09	39.83
8.	.	0.69	2.76	2.05	0.24	1.21	2.36	0.56	0.91	2.70	2.09	36.87
9.	.	0.69	3.82	0.00	2.71	1.21	2.82	0.56	0.14	2.70	2.09	40.42
10.	.	0.69	0.71	1.32	1.41	1.21	2.82	1.88	3.23	0.10	2.09	39.18
11.	.	0.69	3.82	2.05	1.41	0.58	2.82	2.88	2.50	2.70	2.09	38.56
12.	.	0.69	3.82	2.05	0.24	0.32	2.82	0.69	0.14	2.70	2.09	33.48
13.	.	0.69	0.06	2.05	1.41	1.21	2.36	1.88	2.50	2.70	2.09	41.44
14.	.	0.69	3.82	2.05	2.71	1.21	2.82	0.56	0.91	2.70	2.09	40.86
15.	.	0.69	2.76	2.05	2.71	1.21	2.82	0.69	2.50	0.10	2.09	41.16
16.	.	0.69	0.71	0.32	1.41	1.21	2.82	0.69	2.50	0.10	2.09	41.88
17.	.	0.75	3.82	2.05	0.24	0.58	2.82	0.69	2.50	2.70	2.09	42.10
18.	.	0.75	2.76	1.32	0.24	1.79	2.36	1.88	0.91	2.70	2.09	41.70
19.	.	0.69	0.71	2.05	2.71	1.21	2.82	0.69	0.91	2.70	2.09	38.70
20.	.	0.69	2.76	2.05	1.41	1.21	2.82	1.88	0.14		2.09	43.51
Sum Low	15.98	45.91	32.31	37.89	32.75	23.16	50.82	24.67	31.48	32.90	41.80	

INTERNAL CONSISTENCY CONTINUED

(Questions 6, 15, 17, 18, 21, 25, 34, and 35 were rechecked on a sample of 500 subjects. The data for a particular question is averaged and this average was used to modify the sum of high and low cases where a question was not answered by the subject.)

	<u>6</u>	<u>7</u>	Statement Number						<u>18</u>
			<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>15</u>	<u>16</u>	
Sum of High:	59.29	53.68	41.45	67.05	47.91	50.16	57.32	61.94	74.14
Sum of Low :	34.12	32.88	37.49	61.30	5.14	56.77	36.94	26.54	48.11
Difference:	25.17	20.80	3.96	5.75	42.77	-6.61	20.38	35.40	26.03
Differentiat-									
ing power :	1.01	1.04	No	No	2.14	No	0.82	1.77	1.04
									0.85

	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>27</u>	<u>28</u>	<u>29</u>
Sum of High:	48.94	265.42	49.60	43.57	19.04	70.52	69.85	59.24	38.99	28.21
Sum of Low :	23.82	62.74	10.34	10.46	15.98	45.91	36.87	42.09	32.75	23.16
Difference :	25.12	202.68	39.16	33.11	3.06	24.61	32.98	17.15	6.24	5.05
Differentiat-										
ing power :	1.26	10.13	1.57	1.66	No	1.23	1.32	0.86	No	No

INTERNAL CONSISTENCY CONTINUED

	Statement Number			
	<u>30</u>	<u>31</u>	<u>33</u>	<u>34</u> <u>35</u>
Sum of High:	53.18	29.86	60.22	64.00 71.28
Sum of Low :	50.82	24.67	31.48	33.89 51.94
Difference :	2.36	5.19	28.74	31.11 19.34
Differentiat-				
ing power :	No	No	1.44	1.24 0.77

APPENDIX H
MANAGEMENT IDENTIFICATION ATTITUDE SURVEY
REPORT TO PARTICIPATING COMPANIES AND
UNIVERSITIES

MANAGEMENT IDENTIFICATION
SURVEY REPORT

PURDUE UNIVERSITY
Department of General Engineering
Lafayette, Indiana

Prepared by
H. E. Sodke
under the
supervision of
Ralph E. Balyeat
Supervisor of Industrial Relations Courses

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ENGINEERS GROUP MEAN IDENTIFICATION SCORES
- V DATA ON ALL RESPONSES
- VI SUMMARY

SECTION I

INTRODUCTION

This study investigated the variability in certain attitudes expressed by non-supervisory engineers and students in engineering. The study is designed to determine just how an engineer and a student engineer identify themselves with management. How much is the student engineer management orientated in the universities throughout the United States?

As a basis for comparison four stages were chosen to discover whether there might be any significant differences in opinions of groups at various stages of maturity concerning self-identification with management. The stages are: (1) sophomore student engineer, (2) senior student engineer, (3) non-supervisory engineer with less than five years service, and (4) non-supervisory engineer with more than five years service.

A nation-wide survey was selected to provide a more representative sample of all the non-supervisory engineers and engineering students. Thirty companies and universities in the United States agreed to cooperate with Purdue University on this project in response to letters of invitation. One thousand survey forms were sent to the universities, and 55.9 per cent were returned. The number of survey forms sent to the companies totaled four hundred and sixty-seven, and 25.1 per cent were returned. Six weeks were allowed for the return of the survey forms. There were 98 forms that came after this allowed time and these forms were not included in this report.

An identification scale was developed to measure a person's self-identification with management. With this scale a composite score can be determined for each person that completes the questionnaire. The possible scores on the scale measuring attitude toward a person's identification with management range from 3.04 (representing no identification with management) to 62.66 (representing complete identification with management). The identification scale is included in section two and the discriminating power is shown proceeding the statement. The discriminating power is based upon twenty high scoring participants as compared to twenty low scoring participants from a random sample of two hundred subjects. It shows whether the statement differentiates between those that do and those that do not identify themselves with management.

SECTION II

THE MANAGEMENT IDENTIFICATION INDEX

On the basis of judges composed of graduate students and professors, a scale was developed that measures identification with management. The maximum weight value possible on any item response was four for complete identification to zero for no identification with management. The items, when scored, yield an index of a person's management identification.

THE MANAGEMENT IDENTIFICATION INDEX

- (1.01) 6. What is your concept on how management views the relationship of the non-supervisory engineer to management?
- 3.86 a. part of the management team
 - 2.82 b. a professional employee with authority and responsibility
 - 1.41 c. an employee with delegated responsibility
 - 0.32 d. an employee with technical duties
- (1.04) 7. To what extent does the average non-supervisory engineer feel a sense of importance in his company?
- 3.88 a. very high degree of importance
 - 3.00 b. high degree of importance
 - 1.88 c. medium degree of importance
 - 0.75 d. little degree of importance
 - 0.06 e. very little degree of importance
- (2.14) 12. To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?
- 0.00 a. very advantageous
 - 0.05 b. some advantage
 - 0.55 c. very little advantage
 - 1.82 d. no advantage
 - 2.77 e. some disadvantage
 - 3.68 f. considerable disadvantage
- (0.82) 15. To what extent do companies have personnel policies differentiating between engineers and non-professional men?
- 0.11 a. no differentiation
 - 0.94 b. slight differentiation
 - 2.50 c. considerable differentiation
 - 3.56 d. complete differentiation
- (1.77) 16. An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?
- 3.62 a. will considerably minimize his opportunity
 - 2.10 b. will somewhat minimize his opportunity
 - 0.67 c. will not effect his opportunity
 - 0.19 d. will somewhat increase his opportunity
 - 0.00 e. will considerably increase his opportunity

- (1.04) 17. The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.
3.06 a. agree 0.29 c. probably disagree
1.88 b. probably agree 0.06 d. disagree
- (0.85) 18. How often are most engineers informed on company matters of interest and importance to them?
0.00 a. never 2.61 d. usually
0.17 b. seldom 3.67 e. always
1.28 c. occasionally
- (1.26) 19. A company should distribute net profits.
3.28 a. to investors of the concern
2.39 b. to investors and employees at the company's discretion
0.78 c. to investors and employees on a definite basis
- (10.13) 20. Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.
3.23 a. professional status and prestige would be damaged
2.77 b. a "typing" of engineering positions and a "leveling" of salaries would result
0.32 c. the principles and practices of democracy would be enhanced in the engineers group relations with management
2.68 d. the principles and practices of democracy would be endangered in the engineers group relations with management
0.23 e. employment security would be increased
2.91 f. individual initiative would be restricted
0.23 g. reduce undesirable discriminatory treatment
2.73 h. individuals would be regimented by the union organization
0.09 i. economic standing would be improved
- (1.57) 21. Most companies have gone beyond the optimum point providing fringe benefits to employees.
2.88 a. agree 0.47 c. probably disagree
1.76 b. probably agree 0.00 d. disagree
- (1.66) 22. Personnel practices of most companies tend to maximize the contribution of their engineer personnel.
2.94 a. agree 0.50 c. probably disagree
2.25 b. probably agree 0.31 d. disagree

- (1.23) 24. Companies should promote engineers solely on basis of merit.
3.82 a. agree 0.71 c. probably disagree
2.76 b. probably agree 0.06 d. disagree
- (1.32) 25. How often do you feel you will (or) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?
0.32 a. seldom 2.73 c. usually
1.32 b. occasionally 3.77 d. always
- (0.86) 27. To what extent do most industrial unions encroach upon areas that should be reserved for management?
3.57 a. in many areas of management responsibilities
2.05 b. in some areas of management responsibilities
0.00 c. in no areas of management responsibilities
- (1.44) 33. The effect of collective bargaining on advancement for those with a high degree of ability and initiative will.
3.23 a. reduce his opportunities considerably
2.50 b. reduce his opportunities somewhat
0.91 c. no effect on his opportunities
0.14 d. improve his opportunities somewhat
0.00 e. improve his opportunities considerably
- (1.24) 34. If an engineer has a personal problem or grievance it should be discussed and settled.
2.70 a. by his supervisor
2.00 b. by a management panel
0.10 c. by formal grievance procedures
- (0.77) 35. To what extent do you think the industrial policies within a company should be set by management or labor?
3.82 a. it is the management's right to set all policies
2.09 b. decisions made by management with representation of labor on policies affecting employees directly
0.05 c. it is the labor's right to have joint determination on all policies

Maximum possible score.	69.66
Minimum possible score.	<u>3.04</u>
Spread	66.62

SECTION III

COMPARISON OF UNIVERSITIES AND COLLEGES BY STUDENT'S GROUP MEAN IDENTIFICATION SCORES

On the following page, Figure 1, is a bar graph indicating the mean identification score of students within a university or college. The university or college is coded and only the college or university will receive their own code. This is necessary to eliminate any derogatory concepts.

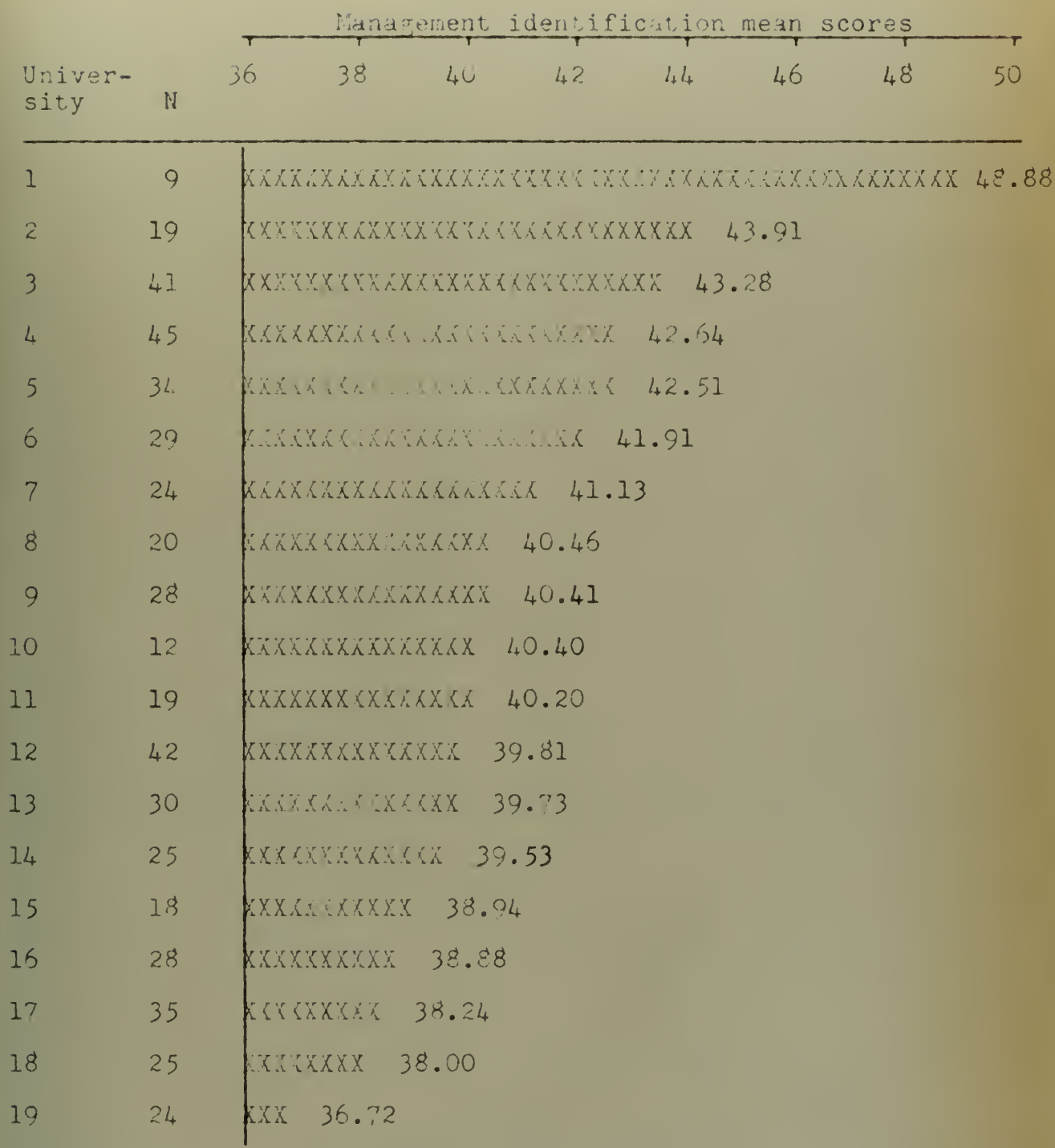


Figure 1

COMPARISON OF UNIVERSITIES AND COLLEGES BY STUDENT'S
GROUP MEAN IDENTIFICATION SCORES

SECTION IV

COMPARISON OF COMPANIES BY NON-SUPERVISORY ENGINEERS GROUP MEAN IDENTIFICATION SCORES

On the following page, figure 2, is a bar graph indicating the mean identification score of non-supervisory engineers within a company. The companies are coded and each will receive their own code. This is necessary to eliminate any derogatory concepts.

SECTION V

DATA ON ALL RESPONSES

This section lists all item responses to the questions. The first column of figures is based on per cent of engineering students answering that item of response. The second column of figures is based on per cent of non-supervisory engineers. The third column of figures is based on per cent of total participants.

Question 6:

What is your concept on how management views the relationship of the non-supervisory engineer to management?

10.0%	8.6%	9.8%	a. part of the management team
31.0	23.7	29.3	b. a professional employee with authority and responsibility
29.4	37.1	31.4	c. an employee with delegated responsibility
26.4	30.1	27.5	d. an employee with technical duties
3.2	0.5	2.7	No answer

The population's concept is that most engineers and engineering students consider that management views them on the average as employees with delegated responsibility. It was thought that a greater percentage would consider themselves part of the management team. The seniors and the engineers with less than three years service are the only groups who are above the total average of 9.8 per cent for item response "a," and they have 10.8 and 12.5 per cent, respectively. There is a trend for seniors to have a more favorable outlook on how management views the relationship of the non-supervisory engineer to management than the sophomores and non-supervisory engineers.

Question 7:

To what extent does the average non-supervisory engineer feel a sense of importance in his company?

4.5%	2.9%	3.5%	a. very high degree of importance
31.6	19.4	28.6	b. high degree of importance
54.0	56.1	54.7	c. medium degree of importance
5.7	14.3	8.9	d. little degree of importance
0.2	2.2	1.1	e. very little degree of importance
4.0	1.1	3.2	No answer

Most participants feel that a non-supervisory engineer has a better than medium degree of importance within his company. Again the seniors indicate a more favorable attitude than the other two groups. The engineers show an 18.3 per cent unfavorable response, indicating a considerable difference in percentage over the 8.9 for the total population. The trend for the engineers in the field is slightly unfavorable for management, since they lean toward lesser degrees of their importance within the company. There is a decrease in the feeling of importance for an engineer as he gains experience. The engineers with more than five years service have a normal distribution centered at medium degree of importance. The engineers with less than three years service show a distribution skewed to a greater degree of importance.

Question 8:

How well do you think most engineers' responsibilities are defined in their organization?

7.9%	7.0%	7.7%	a. very well defined
71.2	64.5	69.7	b. defined on most matters
15.9	25.3	18.3	c. poorly defined
1.4	3.2	1.8	d. not defined
3.6	0.0	2.7	No answer

The findings indicate that the engineers' responsibilities are defined on most matters. Twenty-five per cent of the engineers choose poorly defined, which is approximately ten per cent more than either the sophomores or seniors endorsing this statement. This is a fair indication that the engineer's responsibilities could be better defined.

Question 9:

To what degree do you feel that an engineer knows whether his employer is satisfied with his work?

0.0%	1.1%	0.3%	a. he never knows
10.5	27.9	14.8	b. he seldom knows
83.7	65.6	79.2	c. he usually knows
3.6	4.3	3.8	d. he always knows
2.2	1.1	1.9	No answer

Eighty-three per cent of all students stated that the engineer usually knows whether his employer is satisfied with his work. However, the experienced engineer's opinions show a smaller percentage of sixty-five per cent. One out of every four of the engineers indicated that he seldom knows whether his employer is satisfied with his work.

Question 10:

To what extent do you feel that an engineer has personal freedom in his work situation?

2.3%	2.9%	2.9%	a. very little freedom
43.6	30.1	40.3	b. some freedom
51.4	61.3	53.8	c. considerable freedom
0.5	2.7	1.1	d. complete freedom
2.2	1.1	1.9	No answer

The students feel that the engineer has personal freedom in his work situation between some and considerable freedom. The engineers were more uniform through-out the stages of experience, and approximately 61 per cent said they had considerable freedom.

Question 11:

To what extent do you feel that an engineering background will qualify you for a supervisory or executive position?

33.3%	24.7%	31.1%	a. excellent possibility
51.4	45.2	49.8	b. above average possibility
11.8	25.8	15.3	c. average possibility
2.5	3.2	2.7	d. below average possibility
0.7	0.5	0.7	e. little possibility
0.3	0.5	0.4	No answer

Almost every third person thought it highly possible that an engineering background would qualify them for a supervisory or executive position. The order in which this feeling existed was: seniors, engineers with less than three years service, sophomores, engineers with between three and five years service, and engineers with more than five years service. The trend is an increase toward graduation and a corresponding decrease with years of service.

Question 12:

To what extent do you feel that collective bargaining is or is not or would or would not be advantageous to an engineer?

10.7%	2.2%	9.0%	a. very advantageous
29.3	22.0	27.5	b. some advantage
21.5	23.7	22.0	c. very little advantage
12.9	17.7	14.1	d. no advantage
9.5	11.8	10.1	e. some disadvantage
13.2	17.2	14.2	f. considerable disadvantage
2.9	5.4	3.1	No answer

Better than 10 per cent of all students felt collective bargaining would be very advantageous for the engineer. Approximately one out of every three students and engineers with less than three years of service said it would be of some advantage. The engineers with more than three years service show a slight belief in some disadvantage of collective bargaining for engineers. The population concept shows that 52.5 per cent are in favor of responses "a, b, and c" and 24.3 per cent are in favor of responses "e and f". This indicates that most feel that collective bargaining would help the engineer. However, this is not a strong indication.

Question 13:

Rank in order which you feel will count most in your prospects for promotion.

- | | | | |
|---|---|---|--|
| 5 | 6 | 5 | a. who I know |
| 4 | 5 | 4 | b. length of service |
| 1 | 1 | 1 | c. amount of initiative |
| 2 | 3 | 2 | d. ability to secure cooperation of other |
| 3 | 2 | 3 | e. technical competence |
| 7 | 7 | 7 | f. social activities |
| 6 | 4 | 6 | g. conformity with accepted procedures and practices |
| 8 | 8 | 8 | h. other |

A direct tallying indicated that the total population ranked as above what they thought counted most for promotion. The sophomores had an exact correspondence with this ranking. The seniors ranked as follows: first -- "d"; second -- "c"; third -- "e"; fourth -- "a"; fifth -- "b"; sixth -- "g"; and seventh -- "f".

Question 14:

To secure and retain qualified engineers a company should pay.

- | | | | |
|------|------|------|--|
| 3.9% | 0.5% | 3.1% | a. low wage rate with many employee benefits |
| 44.2 | 43.5 | 44.0 | b. the going rate in the community |
| 49.2 | 54.7 | 50.5 | c. a high wage rate with few fringe benefits |
| 2.7 | 1.6 | 2.4 | No answer |

Most of the students endorsed "b and c" in about equal amounts. The engineers showed a 54 per cent endorsement of a high wage rate with few fringe benefits. There is no trend apparent for the engineers and students on this question.

Question 15:

To what extent do companies have personnel policies differentiating between engineers and non-professional men?

- | | | | |
|------|-------|------|---------------------------------|
| 4.5% | 15.1% | 7.1% | a. no differentiation |
| 35.6 | 46.8 | 38.4 | b. slight differentiation |
| 48.3 | 35.5 | 45.1 | c. considerable differentiation |
| 4.3 | 1.1 | 3.5 | d. complete differentiation |
| 7.3 | 1.6 | 5.9 | No answer |

Most of the subjects stated that most companies have from slight to considerable differentiation between engineers and non-professional men. The greater the experience of an engineer the stronger was the feeling that there was slight differentiation in personnel policies. Sophomores indicated the strongest feeling that there was considerable differentiation, followed by seniors.

Question 16:

An engineer who joins a union is or is not minimizing his opportunity to become an independent consultant?

40.8%	29.6%	37.9%	a. will considerably minimize his opportunity
31.4	31.7	31.4	b. will somewhat minimize his opportunity
10.8	27.4	21.6	c. will not effect his opportunity
3.3	3.2	3.2	d. will somewhat increase his opportunity
0.4	0.0	0.3	e. will considerably increase his opportunity
4.3	8.1	5.6	No answer

Two out of every three subjects stated that an engineer who joins a union will somewhat to considerably minimize his opportunity to become an independent consultant. Forty per cent of the students indicated that he would considerably minimize his opportunities.

Question 17:

The technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions.

55.0%	56.5%	55.3%	a. agree
30.4	28.0	29.8	b. probably agree
8.6	7.5	8.3	c. probably disagree
5.7	7.5	6.2	d. disagree
0.3	0.5	0.4	No answer

It is generally agreed by all that the technical knowhow of the engineer can be applied to all levels of management as well as to the productive functions. The seniors and engineers with less than three years of service showed a greater agreement than the others.

Question 18:

How often are most engineers informed on company matters of interest and importance to them?

0.3%	1.1%	0.5%	a. never
3.8	14.0	6.3	b. seldom
15.5	33.3	20.0	c. occasionally
65.5	45.7	60.5	d. usually
7.9	5.9	7.4	e. always
7.0	0.0	5.2	No answer

The students had over 65 per cent belief that the engineer is usually informed on company matters of interest and importance to him. The engineers had a definite trend towards "c," and better than 14 per cent choose "b," which is a significant difference from the population average.

Question 19:

A company should distribute net profits.

18.4%	18.3%	18.4%	a. to investors of the concern
31.9	31.2	31.7	b. to investors and employees at the company's discretion
48.6	48.4	48.6	c. to investors and employees on a definite basis
1.1	2.2	1.3	No answer

There was no visual trend apparent between the engineers and the engineering students on how a company should distribute net profits. The general feeling of every other participant was that they should be distributed to the investors and employees on a definite basis.

Question 20:

Indicate all that you believe to be true in regard to certification of a collective bargaining unit of technical and professional employees.

58.7%	58.5%	58.6%	a. professional status and prestige would be damaged
70.5	70.5	70.5	b. a "typing" of engineering positions and a "leveling" of salaries would result
15.0	14.4	14.8	c. the principles and practices of democracy would be enhanced in the engineers group relations with management
34.0	34.5	34.2	d. the principles and practices of democracy would be endangered in the engineers group relations with management

Question 20: (continued)

35.8	33.3	35.3	e. employment security would be increased
65.6	65.6	65.6	f. individual initiative would be restricted
19.7	19.5	19.6	g. reduce undesirable discriminatory treatment
54.0	52.9	53.9	h. individuals would be regimented by the union organization
12.3	12.9	12.5	i. economic standing would be improved
9.8	8.5	9.5	No answer

The variance among the groups is not as high as one would expect. In general item responses "a,b,f, and h" show unfavorableness towards the certification of a collective bargaining unit. For these four responses the groups endorsing them were in the following order ---- seniors, engineers with less than three years service, engineers with three to five years service, engineers with more than five years service, and lastly, sophomores.

Fourteen per cent of the sophomores felt that they were not qualified to answer this question. It is generally noted that this population has an unfavorable attitude towards the certification of a collective bargaining unit. The item responses favorable to labor are "c,e,g and i." Of these, approximately 15 per cent of the population checked them, as compared with approximately 60 per cent checking the unfavorable responses to certification of collective bargaining.

Question 21:

Most companies have gone beyond the optimum point providing fringe benefits to employees.

10.9%	13.4%	11.5%	a. agree
36.0	26.9	33.7	b. probably agree
35.6	41.4	37.0	c. probably disagree
13.8	15.1	14.1	d. disagree
3.7	3.2	3.6	No answer

There is only a slight disagreement with this. The sophomores are neutral. The seniors and engineers tend to slightly disagree that most companies have gone beyond the optimum point providing fringe benefits to employees. This may indicate that most companies are approximately at the optimum point.

Question 22:

Personnel practices of most companies tend to maximize the contribution of their engineer personnel.

15.6%	8.6%	13.8%	a. agree
47.2	31.2	43.2	b. probably agree
22.9	36.6	26.3	c. probably disagree
8.8	19.9	11.5	d. disagree
5.5	2.2	5.1	No answer

Over 56 per cent of the engineers indicated a slight disagreement that most companies tend to maximize the contribution of their engineer personnel. Approximately 62 per cent of the students stated a slight agreement with this. It is apparent that the two groups have different feelings on what most companies' personnel practices are; in any case, the personnel practices seem to be adequate.

Question 23:

A company should inform its employees as to the profits of the company.

56.5%	61.8%	57.9%	a. agree
22.7%	26.3	23.6	b. probably agree
10.6	5.4	9.3	c. probably disagree
8.6	4.3	7.5	d. disagree
1.6	2.2	1.7	No answer

There is almost complete agreement that a company should inform its employees as to the profits. The engineers agreed considerably more with this than did the students. In fact, the engineers with less than three years service agreed to the extent of better than 68 per cent stating agreement.

Question 24:

Companies should promote engineers solely on basis of merit.

35.6%	50.0%	39.2%	a. agree
35.0	37.1	35.5	b. probably agree
18.3	8.6	15.8	c. probably disagree
10.4	3.2	8.6	d. disagree
0.7	1.1	0.8	No answer

Seven out of every eight engineers approved or probably approved of promoting engineers on basis of merit. Students did not agree as highly as the engineers in the field.

Their agreement or probable agreement was a little better than two out of every three. The engineers with service between three to five years were the strongest advocates of promoting on basis of merit, followed by the engineers with more than five years service.

Question 25:

How often do you feel you will (or do) have the opportunity to offer your ideas or suggestions when management decisions are to be made which fall within your job area?

6.4%	19.9%	9.8%	a. seldom
34.9	36.6	35.3	b. occasionally
47.3	32.3	43.5	c. usually
7.8	11.3	8.7	d. always
3.6	0.0	2.7	No answer

The students had over 82 per cent endorsement on the response of occasionally and usually, with the sophomores giving about equal weight to each and the seniors tending toward usually. The engineers had a definite trend toward occasionally, and almost 20 per cent indicated they seldom had the opportunity to offer their ideas or suggestions when management decisions which fall within their job area are to be made. The breakdown by engineers showed no significant variations between them.

Question 26:

What do you feel is the chief deterring factor hindering engineers from becoming executives?

9.5%	17.2%	11.0%	a. difficulty in delegating authority and responsibility
9.1	13.4	9.9	b. limited effectiveness of getting results from others
16.6	16.7	16.6	c. inability to apply theoretical knowledge to practical managerial situations
52.7	38.8	50.3	d. inadequate leadership and human-relations skills
9.1	13.4	9.9	e. other
3.0	0.5	2.3	No answer

There is little significant variations in responses made by all groups except on response "d" --- inadequate leadership and human-relations skills. The seniors and engineers with less than three years service both endorsed this statement above 56 per cent each.

The comments that were made fell into several categories. One category was the simple answer of "none." Another was lack of training in business administration principles. A weakness commented by some was that the engineer is too specialized within a particular field.

Others expressed lack of administrative and management training. This is an area in which companies can secure some knowledge of what the engineer thinks he needs training in to become an executive.

Question 27:

To what extent do most industrial unions encroach upon areas that should be reserved for management?

24.5%	21.0%	23.6%	a. in many areas of management responsibilities
67.6	65.6	67.1	b. in some areas of management responsibilities
3.8	4.3	3.9	c. in no areas of management responsibilities
4.1	9.1	5.4	No answer

The general consensus is that the unions do encroach upon some to many areas that should be reserved for management. The sophomore students certified over 28 per cent in many areas. The seniors and engineers with less than three years certified in some areas over 71 per cent.

Question 28:

To what extent do you believe that companies are utilizing effectively the training and ability of the engineer.

0.9%	1.1%	0.9%	a. all of it
42.6	27.4	38.8	b. great portion of it
41.8	48.4	43.5	c. about half of it
11.1	22.6	14.0	d. small portion of it
3.6	0.5	2.8	No answer

Fifty per cent of the sophomore students indicated "b," that they believed that the companies utilize effectively the training and ability of the engineer. The seniors were also high on choice "b." Twenty-seven per cent of the engineers in the field believed a great portion of the training and ability of the engineers was being effectively utilized by the companies. This is just about half of the percentage for the sophomores. Almost one out of every four engineers expressed that the companies are utilizing a small portion of their training and ability. There is a definite tendency to responses "c and d" for the engineers as compared with students.

Question 29:

Most industrial non-supervisory workers are.

0.9%	1.1%	0.9%	a. considerably overworked
12.3	7.0	11.0	b. somewhat overworked
56.4	50.1	57.1	c. neither overworked or underworked
23.2	24.2	21.5	d. somewhat underworked
1.6	2.9	2.4	e. considerably underworked
5.6	2.2	5.1	No answer

There was no considerable variation among the groups. Twenty-six per cent of the seniors stated that the industrial non-supervisory workers were somewhat underworked. The majority felt that they were neither overworked nor underworked, and to a small extent somewhat underworked.

Question 30:

In the long run an engineer can best further his economic objectives by:

31.4%	23.7%	29.5%	a. doing his assigned work as efficiently as he knows how
65.0	72.0	66.7	b. perform assigned work adequately with constant attempts to assume greater responsibilities
2.0	3.2	2.3	c. join a collective bargaining union in demanding greater recognition of worth
1.6	1.1	1.5	No answer

Approximately every third student answered doing his assigned work as efficiently as he knows how, as compared with approximately every fourth engineer checking the same response. Approximately three out of every four engineers said an engineer should perform assigned work adequately, with constant attempts to assume greater responsibilities. A very small percentage of 2.3 stated that the engineer should join a collective bargaining union in demanding greater recognition of worth.

Question 31:

As productivity and automation increase companies should grant their industrial workers a shorter work week without reducing take home pay.

25.4%	25.8%	25.5%	a. agree
33.8	39.2	35.2	b. probably agree
24.5	21.5	23.8	c. probably disagree
13.1	11.8	12.8	d. disagree
3.2	1.6	2.8	No answer

Sixty-five per cent of the engineers agree or probably agreed with the shorter work week. The variations among the groups were small. The group that most agreed with a shorter work week were the engineers with more than five years service.

Question 32:

Most industrial non-supervisory workers are.

1.8%	2.2%	1.9%	a. considerably overpaid
18.6	10.8	16.6	b. somewhat overpaid
61.2	56.5	60.8	c. neither overpaid or underpaid
12.7	26.3	16.1	d. somewhat underpaid
0.5	1.1	0.7	e. considerably underpaid
5.2	3.1	4.7	No answer

The responses gave a normal distribution, with all participants stating that most industrial non-supervisory workers are neither overpaid nor underpaid. The students varied to somewhat overpaid, and the engineers counter-acted to make the normal distribution of all subjects by stating they were somewhat underpaid.

Question 33:

The effect of collective bargaining on advancement for those with a high degree of ability and initiative will.

37.2%	42.5%	38.5%	a. reduce his opportunities considerably
39.9	36.0	38.9	b. reduce his opportunities somewhat
10.6	14.0	11.4	c. no effect on his opportunities
7.0	5.9	6.7	d. improve his opportunities somewhat
1.2	0.6	0.9	e. improve his opportunities considerably
4.1	1.6	3.5	No answer

Better than 67 per cent of the population believed it would somewhat to considerably reduce his opportunities in advancement. The engineers were more positive in this belief with the group of engineers with three to five years service having better than 81 per cent. The sophomores were the least receptive of responses "a and b."

Question 34:

If an engineer has a personal problem or grievance it should be discussed and settled.

57.7%	71.5%	61.1%	a. by his supervisor
24.2	14.5	21.7	b. by a management panel
9.1	6.5	8.5	c. by formal grievance procedures

Question 34:(continued)

5.6%	6.5%	5.9%	d. other
3.4	1.1	4.7	No answer

Over seventy-one per cent of the engineers thought that it should be settled by his supervisor, with engineers having three to five years service and engineers with less than three years service showing the greatest belief. The sophomores showed the least reception to "a" with 50 per cent, taking up the remaining percentage by checking "d" and leaving it blank.

The "others" given were generally statements such as "contact an outside person," "see the personnel advisor," or "discuss and settle with the supervisor's supervisor."

Question 35:

To what extent do you think the industrial policies within a company should be set by management or labor?

11.3%	18.3%	13.0%	a. it is the management's right to set all policies
82.6	78.0	81.5	b. decisions made by management with representation of labor on policies affecting employees directly
4.5	2.2	3.9	c. it is the labor's right to have joint determination on all policies
1.6	1.6	1.6	No answer

Most of the subjects feel that decisions on industrial policies should be made by management with representation of labor on policies affecting employees directly. Almost one out of every five engineers felt it was the management's right to set all policies, with the engineers having less than three years service endorsing this response the most. A very small percentage of 3.9 per cent thought that it is the laborers' right to have joint determination on all policies.

SECTION VI

SUMMARY

The role of non-supervisory engineers in modern industry has changed in the last several decades. Some managements have taken steps to modify this role, but necessarily have done so with a minimum of factual information concerning it. The research reported here is designed to throw some light on the effect of a non-supervisory engineer's identification with management. Since the relationship between engineer and manager is by its very nature a changing and flexible affair, it is felt that the hypotheses made on engineers-management relations has within it concepts adequate to deal with the dynamics of this relationship. A measure of management identification was developed for use in determining effects of the non-supervisory engineer's role in management.

The following findings are submitted:

1. The student engineers and non-supervisory engineers were compared to determine if a difference existed. There was a decrease in identification for the non-supervisory engineers which is significant at the five per cent level of confidence. At the five per cent level, implies that the sample mean difference is so great that it would occur in less than five per cent of the samples from the population.
2. The null hypothesis that there is no difference in the mean identification scores between the groups at various stages of maturity of the non-supervisory engineer is rejected. A significant difference was found to exist between the sophomores and seniors, between seniors and engineers with less than five years service, and between seniors and engineers with more than five years service. Sophomore students are found to have less identification with management than seniors; and non-supervisory engineers with five or more years of experience are found to have less identification with management than those with less than five years experience.
3. The non-supervisory engineers who belonged to an engineering society were compared with those who do not belong, to determine whether any difference in identification existed. There was a greater identification for those who belonged to an engineering society, but at the sixty per cent level of confidence and the null hypothesis was accepted.
4. It was found that in our universities there was considerable variations in the student's self identification with management.

5. Considerable variations in self-identification with management for the non-supervisory engineers existed within various companies.

6. In the comparison of branch of engineering relative to identification, it was found that inspection, production and industrial branches were higher than the others. A suggested interpretation is that the more authority and contact with industrial workers the branch of engineering has, the greater the degree of self-identification with management for the engineer within that branch.

7. In comparing non-supervisory engineers in their general work classifications it was found that industrial, mathematics, and chemical had a high degree of identification with management.

The findings, regarding data on all questions, are submitted and are located in section five.

When the engineer's slide rule is joined by the latest and most practical findings on human motivation and behavior, when the engineer can use both tools to solve executive problems as needed, then we will have a competent corps of engineers to fill the billets of industrial management.

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An analysis of the
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An analysis of the extent to
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